REMEDIAL ACTION CONSTRUCTION SUMMARY REPORT

UPLAND CAP

MCCORMICK & BAXTER CREOSOTING COMPANY
PORTLAND, OREGON

May 2006

Task Order No. 71-03-21

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DEQ
State of Oregon
Department of Environmental Quality

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ecology and environment, inc.

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Prepared for:

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY
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Portland, Oregon 97204

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List of Acronyms

ACB	articulated concrete block
AINW	Archaeological Investigations Northwest
ASTM	American Society for Testing and Materials
BAA	Biological Assessment Addendum
BGS	below ground surface
BIOP	Biological Opinion
BMP	best management practices
BMRP	Biological Monitoring and Reporting Plan
BNRR	Burlington Northern Railroad
CO	Change Order
COP	Construction Operations Plan
CQAP	Construction Quality Assurance Plan
CQC	Construction Quality Control Plan
CSR	Construction Summary Report
DAS	Oregon Department of Administrative Services
DEA	Dean Evans and Associates
DEQ	Oregon Department of Environmental Quality
DOJ	Oregon Department of Justice
DNAPL	denser-than-water non-aqueous-phase liquid
E&E	Ecology and Environment, Inc.
EPA	United States Environmental Protection Agency
ESA	Endangered Species Act
ESCP	Erosion and Sediment Control Plan
ESD	Explanation of Significant Difference
ET	evapotranspiration
FWDA	Former Waste Disposal Area
GPS	global positioning system

List of Acronyms (Cont.)

HDPE	high-density polyethylene
LGP	low ground pressure
LNAPL	lighter-than-water non-aqueous-phase liquid
MBI	Morse Brothers, Inc.
McCormick & Baxter	McCormick & Baxter Creosoting Company, Portland Plant
mg/L	milligrams per liter
MH	manhole
Mm	millimeter
NAPL	non-aqueous-phase liquid
NGVD	National Geodetic Vertical Datum
NOAA	National Oceanic and Atmospheric Administration
NOAA Fisheries	National Oceanic and Atmospheric Administration National Marine Fisheries
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NW	Northwest
NWL	Northwest Linings
ODOT	Oregon Department of Transportation
OHW	Ordinary High Water
OSHA	Occupational Safety and Health Administration
OWRD	Oregon Water Resources Department
oz	ounce
PacRim	PacRim Geotechnical, Inc.
PAHs	polynuclear aromatic hydrocarbons
PCP	pentachlorophenol
PCP	Pollution Control Plan
PLS	Pure Live Seed
psi	pounds per square inch
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control

List of Acronyms (Cont.)

QCI	Quality Control Inspector
RA	remedial action
RAOs	remedial action objectives
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RISG	Ross Island Sand and Gravel
ROD	Record of Decision
sf	square feet
SS	stainless steel
TFA	Tank Farm Area
TRM	Turf Reinforcement Mat
UPRR	Union Pacific Railroad
USACE	United States Army Corps of Engineers

1 Introduction

Ecology and Environment, Inc., (E&E) under contract with the Oregon Department of Environmental Quality (DEQ), has prepared this Remedial Action (RA) Construction Summary Report (CSR) to document remedial actions implemented to address contaminated soil at the McCormick & Baxter Creosoting Company, Portland Plant (McCormick & Baxter) Superfund Site in Portland, Oregon (Figure 1-1).

This document has been prepared under DEQ Task Order No. 71-03-21, which concerns implementation of Remedial Design (RD)/Remedial Action (RA) activities at the site in accordance with the remedy described in the *Record of Decision* (ROD; EPA/DEQ 1996), the March 1998 *ROD Amendment* (EPA/DEQ 1998), and the August 2002 *Explanation of Significant Difference* (ESD; EPA/DEQ 2002). The RA addressed by this document consists of the construction of an upland cap, which was identified in the ROD as a component of the soil remedy (see Section 1.2, below).

Prior to and concurrent with the upland cap construction work described in this document, additional construction work was performed at the site in support of the RA including: demolition and removal of remaining site structures; and installation of new support facility features. This work was completed under two separate subcontracts to E&E. CSRs for the work performed under these two subcontracts are included under separate cover: *Demolition and Removal Construction Summary Report* (E&E 2006); and *Support Facility Modifications Construction Summary Report* (E&E 2006).

1.1 Site Location and Description

Located on the east bank of the Willamette River near river mile 7, the site encompasses approximately 41 acres on land and 23 acres in the river. The site is situated downstream of Swan Island and upstream of St. John's Bridge. The upland portion is on a terrace of imported sand fill (dredged material placed in the early 1900s) within the floodplain of the Willamette River. The upland area is generally flat and lies between a 120-foot-high bluff along its northeastern border and a 20-foot-high bank along the Willamette River to the southwest. Prior to construction activities during 2004 and 2005, a sandy beach was exposed at the base of the bank except during periods of high river stage, which generally occur during late winter or early spring.

The site is bordered to the south by vacant industrial properties and on the top of the bluff by a residential area. Burlington Northern Railroad (BNRR) tracks on an embankment bounds the northwestern portion of the property and the Union Pacific Railroad (UPRR) separates the site from the toe of the bluff.

The property is accessed via the partially paved North Edgewater Street, which leads from Willamette Boulevard to the main gate near the northwest corner of the site. Construction of the RAs has modified the site entrance and most man-made features at the site. Prior to construction during the summer of 2003, the site was described as follows.

The driveway leading into the property and the parking lot are paved; the remainder of the property is unpaved, covered with gravel, or vegetated. Two construction trailers are maintained in the parking lot area to provide office space, storage, and personnel decontamination facilities for ongoing site activities. The remaining aboveground structures on site include: a former shop building that used to house a water treatment system (no longer in operation) and other equipment/supplies; a freight container located near the western property corner, which also formerly housed a water treatment system (no longer in operation); four aboveground tanks used for water treatment operations (no longer in operation); a small metal shed containing a water service backflow prevention device; several utility poles; and a wood retaining wall and pilings along the river bank. All other aboveground structures and buildings were removed during previous RA activities.

A combination steel sheet pile and soil-clay slurry subsurface barrier wall was constructed during the summer of 2003. During the construction of the barrier wall, the wooden retaining wall and pilings accessible by land equipment were removed. Additionally, several wells were abandoned and the bank along the river was laid back to a temporary slope and seeded.

During the summer of 2004, a sediment cap was constructed in the river and along the river bank. The cap consisted of sand, gravel, and rock armoring (cobbles and boulders) as well as articulated concrete block (ACB) placed in lieu of rock armoring. The river bank was laid back to a final slope, and protected with turf reinforcement mat (TRM) and final seeding with native species. Several wells were abandoned during this period. The sediment cap was completed in the summer of 2005 in the area surrounding two high pressure sewer lines owned by the City of Portland.

During the spring of 2005, all existing manmade features exclusive of the support area were demolished, except for the blackflow preventer. The backflow preventer was relocated to a new vault near the eastern boundary and connected to a new waterline leading to the support area. See the *Demolition and Removal Construction Summary Report* (E&E 2006) for additional details related to this work.

During this same period, the support area was raised 2 feet and a new shop building, hazardous waste storage area, and area lighting were constructed. New utilities including telephone, electric, and water were also installed to service the support facility area. See the *Support Facility Modifications Summary Report* (E&E 2006) for additional details related to this work.

During the summer of 2005, an upland cap was constructed, which is the subject of this CSR.

1.2 Site Background and ROD Requirements

McCormick & Baxter was founded in the early 1940s to produce a variety of treated wood products during World War II. Various wood treatment processes were used at the site including pentachlorophenol (PCP), creosote formulations, ammoniacal copper/zinc arsenate, a copper/chromium/arsenic formulation, and Cellon. Site investigation between 1983 and 1990 revealed many releases of chemical compounds to soil, groundwater, and sediment. Contaminants detected at the site include polynuclear aromatic hydrocarbons (comprising about 85% of creosote constituents), PCP, arsenic, chromium, copper, and zinc. In 1990, the wood treatment operations ceased and early RAs were initiated to remove process equipment, piping, tanks, treatment formulations, and other items.

The ROD identifies selected remedies for contaminated groundwater, sediment, and soil. Over the past several years, a number of inspections, investigations, and RAs have been performed at the site.

Groundwater remedial activities included extracting and treating groundwater, which was then released into the Willamette River (implemented in 1994 and suspended in September 2000) and installation in 2003 of a vertical barrier wall to attain hydraulic control of nonaqueous phase liquid (NAPL) and groundwater and reduce off-site NAPL migration. Groundwater/NAPL extraction has occurred since 1994, first as an automated process, but transitioning to manual methods in 1998 when NAPL recovery diminished. Monitoring to ensure that site-specific alternate concentration limits are met at compliance monitoring locations is ongoing.

The alignment of the vertical barrier wall consists of a fully encompassing wall; the downgradient portion (paralleling the Willamette River) is constructed of steel sheet pile, and the upgradient/upland portion consists of a soil-bentonite slurry wall. Post-installation groundwater monitoring had implications for the design and construction of the sediment remedy described in this report.

The remedy for sediment, as specified in the ROD, was the capping of near-shore contaminated sediment and the initiation of long-term monitoring, operation and maintenance, and institutional controls. The majority of the sediment cap was constructed in 2004 (completed November 2004) except for a portion near two exposed City of Portland sewer lines, which was not completed until September 2005 following sewerline stabilization. In addition, as part of the 2004 sediment cap construction contract, the river bank was regraded (i.e., flattened) and capped with two feet of clean fill up to the top of bank near where riparian habitat zones had been planned.

Phase I of the soil remedy was performed in 1999, where the most highly contaminated soil was excavated to 4 feet or more below ground surface and disposed of off site as hazardous waste. Clean, sandy fill was placed in those areas that were excavated. Phase II of the soil remedy, as specified in the ROD, entails the installation of a soil cap, the subject of this document.

As specified in the ROD, the objective of the soil cap remedy is to provide protection against direct contact with residual contamination that exceeds risk-based or background concentrations. Based on several investigations which indicated widespread residual contamination throughout the site, it was determined that the most logical approach was to cap the entire site.

In early 2004, E&E prepared a *Soil Cap Design Criteria Report* (E&E, February 2004), which described the criteria for the basis of the design for the cap. This document was submitted to the project team consisting of DEQ, the United States Environmental Protection Agency (EPA), the United States Army Corps of Engineers (USACE), various Native American tribes[1], the National Oceanic and Atmospheric Administration (NOAA) and the NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS). Based on concerns of several project team reviewers, the design approach was modified to reduce rainwater infiltration by increasing the degree of evapotranspiration. Subsequently, E&E produced the *Upland Cap Pre-Final Design Report* (E&E, July 2004) which provided a technical design for an Evapotranspiration (ET) Cap with numerous supporting studies and a comparison of costs and schedules for implementing an ET Cap versus a RCRA-type impermeable cap. Several project team reviewers expressed further concerns that an ET Cap would not provide sufficient reduction of rainwater infiltration and could result in continued NAPL flow to the river. As a result of these concerns, E&E and DEQ conducted additional studies to better determine the effectiveness of the ET Cap versus a RCRA-type impermeable cap. Results of the additional studies were presented to the project team, but consensus on the upland cap design could not be reached by all parties at that time. The

[1] Confederated Tribes and Bands of the Yakama Nation, Confederated Tribes of the Grand Ronde Community, Confederated Tribes of Siletz Indians, Confederated Tribes of the Umatilla Indian Reservation, Confederated Tribes of the Warm Springs Reservation of Oregon, and the Nez Perce Tribe.

design issues were subsequently presented to the DEQ's NW Region Division Administrator (Dick Pedersen), EPA Unit Manager (Dan Opalski), and the Tribes' lead representative (Brian Cunninghame) on September 15, 2004. During the meeting, it was determined that the cap would consist of the following: an impermeable cap (i.e., multi-layer cap with a geomembrane serving as a hydraulic barrier) over the upland portion of the site within the barrier wall; and an ET cap (i.e., vegetated soil cap) over the riverbank riparian area within the barrier wall and over all other areas of the site outside of the barrier wall. A copy of the decision meeting minutes is included as Appendix A.

In March 2005, E&E completed the contract documents for the construction of the upland cap, which included contract requirements, technical specifications, and drawings. Thereafter, the DEQ, with assistance from the Oregon Department of Administrative Services (DAS), solicited bids for construction of the cap. On May 10, 2005, the contract was awarded and the notice to proceed was issued to Wilder Construction Company (Wilder), based in Everett, Washington.

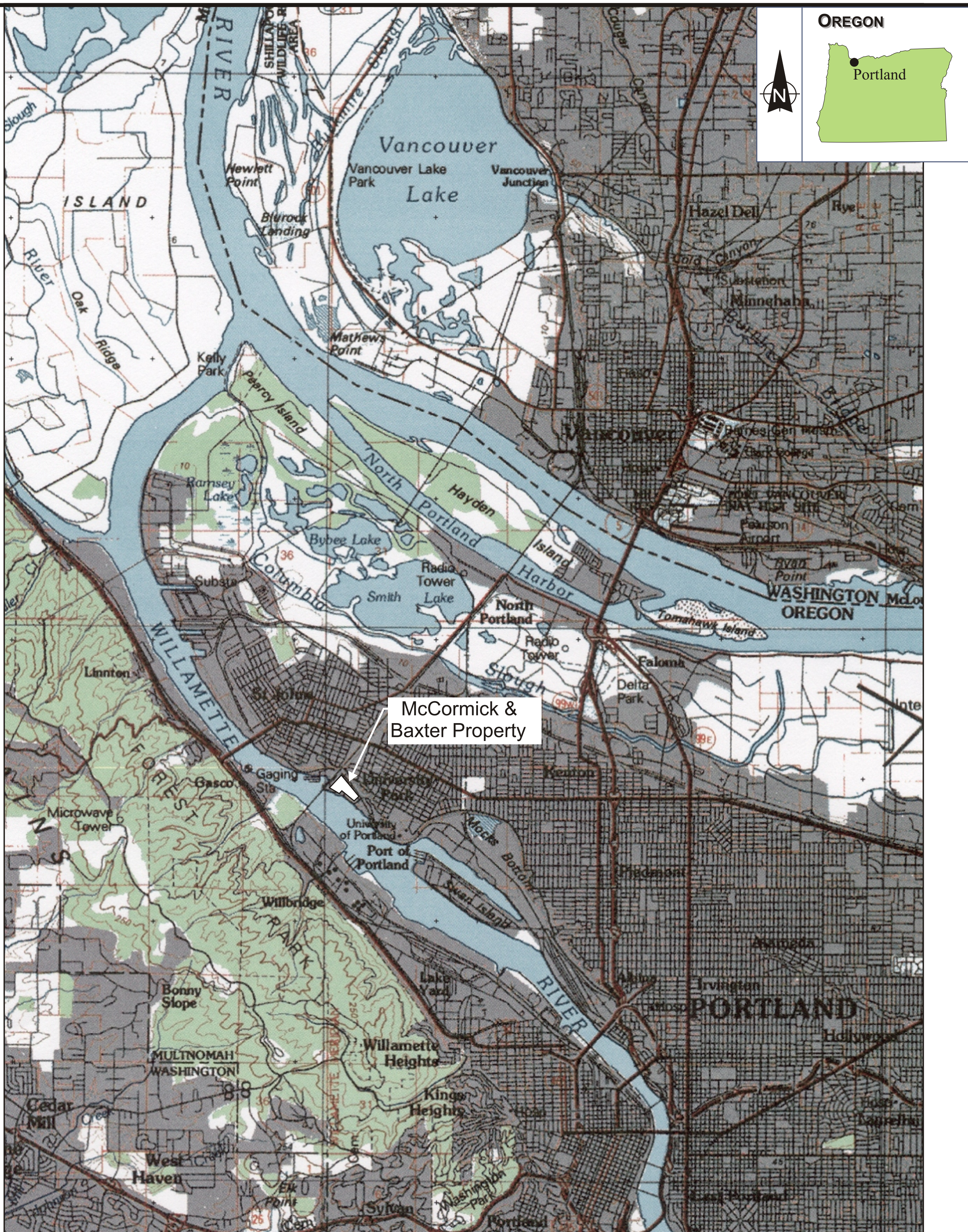
1.3 Report Objectives and Organization

The purpose of this report is to:

- Provide a summary of the upland cap construction RA site activities performed by E&E and Wilder, including descriptions of construction materials, equipment, and methods; and quality control (QC) and quality assurance (QA) procedures.
- Explain project deviations and modifications made during the RA (e.g., change orders);
- Present a condensed summary of the weekly reports provided to DEQ, including a chronology of major events;
- Describe community relations activities;
- Present Record Drawings;
- Present photodocumentation; and
- Document RA construction quantities and costs.

The organization of this report is as follows:

- Section 2 provides details of the RA implementation including contracting and subcontracting; a summary of pre-construction and construction activities; change orders and project deviations; health and safety; community and Tribal relations; documentation (e.g., photodocumentation and record drawings); and a chronology of major events;
- Section 3 documents RA construction quantities and costs; and
- Section 4 lists the references used to complete this report.



ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

McCORMICK AND BAXTER
CREOSOTING COMPANY SITE
Portland, Oregon

Figure 1-1

SITE LOCATION MAP

Date:
1-9-06

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2 Remedial Action Implementation

The following subsections provide details of the RA implementation including contracting and subcontracting; pre-construction activities; construction activities; problems encountered, corrective actions, and project deviations; health and safety; community relations; documentation; and chronology of major events.

2.1 Contracting and Subcontracting

E&E, under contract with DEQ, provided environmental engineering and consulting services to implement RD/RA activities including oversight of RAs and the remedial contractors. Activities were conducted in accordance with the ROD, amended ROD, ESD, and DEQ task orders. E&E was responsible for preparation of work plans, implementation of field investigation activities, preparation of data summary documents, and preparation of the engineering designs and specifications related to remediation activities. E&E also provided assistance to DEQ regarding preparation of the contract documents required for procurement of the RA construction contractors.

For the RA construction phase of the project, E&E provided construction oversight services and technical management assistance to DEQ. In this role, E&E assisted DEQ with public relations, project data management, reporting and documentation, resolution of technical issues, and approval of technical submittals. During the RA, E&E provided oversight engineers to monitor contractor performance and compliance with the contract requirements, conduct inspections, and document work progress and modifications. To assist with the testing and inspection of earthen material submittals, E&E subcontracted PacRim Geotechnical, Inc. (PacRim), of Portland, Oregon.

After a competitive public procurement process by DAS and DEQ, the construction contract was awarded to Wilder Construction Company (Wilder), based in Everett, Washington. Wilder and their subcontractors were responsible for the physical implementation of the fieldwork specified in the contract documents. Wilder was DEQ’s prime contractor for the project. As the prime contractor, Wilder provided physical labor and operations management for the project. Wilder also provided project management of the subcontractors and the material and equipment vendors that were required to complete construction of the upland cap. Subcontractor and vendor lists are provided below.

Subcontractors and Vendors:

- Allwood Industries of Vancouver, Washington: grinding/chipping of branches and brush.
- Cascade Drilling of Portland, Oregon: supplied well materials and performed well modifications and well drilling services.
- David Evans & Associates, Inc. (DEA), of Portland, Oregon: provided surveying services.
- Drew Martin of Portland, Oregon: on-site fueling services.
- Eagle-Elsner, Inc., of Tigard Oregon: performed final grading and installed the pavement for the support area.
- Ferguson Industrial Plastics (formerly Familian Northwest) of Portland, Oregon: performed onsite manhole modifications and HDPE welding.
- Glacier Northwest of Portland, Oregon: supplied concrete for outfall structure.
- Hanson Pipe and Products of Portland, Oregon: supplied a pre-cast concrete manhole (MH E) with ladder and the pre-cast concrete manhole pads with frames and covers.
- H.D. Fowler of Clackamas, Oregon: supplied
    - high density polyethylene (HDPE) perforated pipe for stormwater collection within the drainage layer;
    - smooth-walled HDPE pipe for stormwater conveyance within the barrier wall (interior double containment pipe);
    - Hancor double-walled corrugated pipe for manhole fabrication, stormwater conveyance pipe outside the barrier wall (from MH E to the outfall), and secondary containment pipe (exterior pipe) within the barrier wall.
    - polyvinyl chloride (PVC) pipe for constructing the gas vents;
    - plastic valve boxes used for gas vent and cleanout vaults; and
    - manhole ladders.
- Morse Brothers, Inc. (MBI), of Portland, Oregon: supplied
    - 1.5-inch minus base rock for the roads;
    - 4-inch minus rock for the biotic layer;
    - 12-inch minus rock for armoring of the outfall and spillway
    - 24-inch minus (riprap) rock for repairs to the sediment cap armoring; and
    - topsoil for portions of the vegetated topsoil layer and soil cap.
- Northwest Geotech, Inc. of Portland, Oregon: provided compaction testing services.
- Northwest Hydro-Mulchers, Inc., of Boring, Oregon: supplied and applied compost and hydroseed.
- Northwest Linings and Geotextile Producte, Inc. (NWL), of Kent, Washington: supplied HDPE geomembrane liner, geocomposite, erosion control netting, demarcation fabric (orange HDPE warning barrier fence)

and geotextile materials; and installed the geomembrane and geocomposite.

- Portland Precision Instruments of Portland, Oregon: provided the global positioning system (GPS) equipment and software for the automated grade control and positioning system.
- Ross Island Sand and Gravel (RISG) of Portland, Oregon: supplied sand for the leveling and drainage layers, and topsoil for portions of the vegetated topsoil layer and soil cap; and performed material barge off-loading. Materials were obtained from a pit located in Avery, Washington, from Pacific Northwest Aggregates, Inc., a wholly owned subsidiary of RISG.
- Willamette Fence of Portland, Oregon: supplied, installed, and repaired chain-link fencing.

2.2 Pre-Construction Activities

This section summarizes the pre-construction activities including meetings, submittal delivery and review procedures, and permitting.

2.2.1 Pre-Construction and Preparatory Meetings

Prior to construction activities, a required pre-construction meeting was held on June 1, 2005. Attendees included DEQ's project manager and contract officer; E&E's project manager, project engineer, senior engineer, oversight supervisor, and quality assurance inspector; and Wilder's key project personnel including the project manager, site superintendent, and quality control inspector. The topics presented and discussed during the meeting included staff introductions; a scope of work summary; relevant documents; submittal requirements; health and safety; site access and transportation; site constraints; construction schedule and sequencing; and construction procedures and testing.

2.2.2 Submittals

Per Section 01300 of the *Contract Documents - Upland Cap* (E&E 2005), Wilder and their subcontractors and/or vendors were required to prepare and deliver submittals to E&E including plans [e.g., construction operations plan (COP) and health and safety plan, etc.], shop drawings, and product data on materials and equipment. The submittal delivery and review procedure was established at the beginning of the project and refined throughout. The steps in the submittal procedure were as follows:

1. Wilder delivered submittals to E&E with an associated electronic copy of a transmittal and tracking form. Information contained on the form included a description of the material or product; a reference to the applicable specification section or sections; an area for the reviewing engineer to present the results of the review; and the submittal number with serial tracking number (re-submittal number). A majority of the submittals were delivered as hardcopies per the Contract Documents.

However, certain pre-approved exceptions were allowed in which the delivery of the submittal was made electronically via email. The specified numbers of hardcopies of the submittal (six) were delivered to E&E's field office trailer for distribution.

2. Upon reception of each submittal, E&E recorded the delivery in a log and then prepared it for distribution. Submittals that were not time critical were distributed weekly during the Weekly Progress Meetings. Submittals that required expedited review were mailed as overnight delivery to the reviewing engineer(s). Submittals that were delivered electronically via email were tracked following a similar log-in and distribution procedure to ensure accurate tracking.

3. The results of the review process were recorded on the associated electronic cover sheet, which was then returned via email to Wilder with comments attached, as applicable. If the submittal was rejected or additional information was requested by the engineer, then the process was repeated until all required information was received and approved. Tracking forms and logs were updated with a re-submittal number, which was the addition of a number suffix to the original submittal number (e.g. 13.1, 13.2, etc.).

4. Per requirements stated in the contract documents, Wilder's Quality Control Inspector (QCI) maintained and presented at each weekly progress meeting an updated Submittal Log which included the date of the submittal, the date of E&E's response, and the status (e.g., accepted, rejected, accepted with comments, etc.).

The submittals were generally prepared in accordance with the time requirements specified in the Contract Documents and were submitted to E&E and DEQ for review prior to plan implementation and/or material/equipment purchase and/or delivery. Appendix B contains a copy of the Submittal Log and copies of select material submittals (e.g., geosynthetics with material samples, piping). Appendix E also contains submittal information (e.g., grain size analysis results) for soil materials. A complete set of the submittals are on file at the DEQ and E&E offices in Portland.

2.2.3 Permits and Regulatory Compliance

Prior to commencing construction activities, Wilder was required to obtain a National Pollutant Discharge Elimination System (NPDES) Storm Water Discharge Permit #1200-C from DEQ. This storm water control permit covered construction activities including clearing, grading, excavation, and stockpiling; and authorized construction/operation of erosion and sediment control measures and storm water management in conformance with permit requirements. Consistent with the requirements of the NPDES 1200-C permit, Wilder

Construction also developed an *Erosion and Sediment Control Plan* (ESCP) to describe the best management practices (BMPs) to minimize erosion and sediment runoff at the site; identify, reduce, eliminate, or prevent the pollution of stormwater; and prevent violations of surface water quality or groundwater quality standards. Copies of the 1200-C permit and the ESCP are included in Wilder Construction's COP (submittal number 009).

Substantive compliance with regulations prescribed under the Endangered Species Act (ESA) was also required since upland cap construction activities had the potential to impact federally listed salmonid species (e.g., chinook salmon) in the adjacent Willamette River. In January 2005, pursuant to Section 7 of the Endangered Species Act, the EPA submitted a *Biological Assessment Addendum (BAA) III* (EPA 2005) to the National Oceanic and Atmospheric Administration National Marine Fisheries (NOAA Fisheries) to address these possible effects. Within the BAA, EPA recommended conservation measures to reduce or eliminate potential impacts. These conservation measures were included in the soil cap construction contract specifications and were required to be followed by the construction contractor. Furthermore, E&E prescribed oversight tasks related to the conservation measures in the Environmental Monitoring section of the CQAP. During construction, E&E implemented these prescribed tasks to ensure that the conservation measures were followed by Wilder and its subcontractors. A copy of the BAA has been attached to this document in Appendix C. Since the BAA concluded that construction of the soil cap was not likely to adversely effect listed species, a *Biological Opinion* was not issued by NOAA Fisheries.

2.3 Construction Activities

Construction of the upland cap consisted of the following major components:

- General Mobilization and Site Preparation;
- Impermeable Cap Construction;
- Soil Cap Construction; and
- Other Construction Activities (e.g., gravel road construction, fencing installation, hydroseeding, monitoring well installation, waste disposal, asphalt pad construction, and organoclay mat installation).

Details related to each of these components are provided below.

2.3.1 General Mobilization and Site Preparation

2.3.1.1 General Mobilization

The two existing site trailers located in the support zone were utilized by E&E, DEQ, and visitors for office and contamination reduction facilities. Wilder mobilized and installed a temporary office trailer for their use. Wilder's trailer was temporarily connected to telephone and electric utilities for the construction duration. In addition to their office trailer, Wilder mobilized and stored a semi-truck trailer within the support zone for secure storage of equipment, tools, and hazardous materials; and provided portable field lavatories with hand wash stations.

The materials and equipment used to construct the upland cap were mobilized to the site via barge and trucks. Details related to each item are discussed in Sections 2.3.2 and 2.3.3, below.

2.3.1.2 Site Preparation

Clearing and Grubbing

Clearing consisted of removing unwanted materials from the soil cap area including trees, brush, downed timbers and rotted wood, rubbish, concrete, piping, and existing stockpiles of large woody debris. Non-vegetative hazardous and non-hazardous materials were segregated and stockpiled. The materials were then placed in appropriately marked roll-off containers for transport and disposal at offsite landfills.

Trees were separated from their root balls. Vegetative debris was chipped and spread in designated areas outside of the barrier wall prior to placement of capping soils. Large diameter logs from the clearing operations and those existing in the large woody debris stockpiles (generated from previous RA activities) were carefully placed along the top of river bank outside of the upland cap area as a habitat mitigation measure. The logs were placed a few feet downslope or as far as possible without damaging or creating cross contamination in the transition zone between the upland cap and the bank that was regarded and capped with topsoil during last year's RA activities.

Grubbing consisted of the removal of unwanted materials from below the existing ground surface. Wilder Construction utilized a grader with ripping teeth to scarify (till) the surface. As with the clearing operations, non-vegetative hazardous and non-hazardous material were segregated and stockpiled for disposal. The materials were then placed in appropriately marked roll-off containers for transport and disposal at offsite landfills.

2.3.1.3 Survey Control

During the initial phase of construction, Wilder's surveying subcontractor, DEA, performed a control survey for orientation of a 3D GPS positioning system (manufactured by Topcon®), which was used by Wilder throughout construction. During this survey, a temporary benchmark hub was set using survey control from the permanent benchmarks (i.e., brass caps in concrete) existing onsite. This hub was then used for orientation (i.e., coordinates and elevation) of the Topcon® localized GPS correction beacon, or base station, from which GPS receivers and automated hydraulic blade control systems received positional and elevation data. This system was utilized for automated grading and equipment control; and for construction feature layout, inspection, and documentation.

Automated Grading and Equipment Control
The 3D GPS system measures the easting (X), northing (Y), and elevation (Z) coordinates of a machine's blade and compares the data to a preloaded computer-generated surface of the area under construction. The design elevation and cross-slope for the current position are then calculated for the current position, and the system automatically moves the blade to the correct cut or fill position elevation and slope via the machine's hydraulics. Grade and slope information along with the blade's position are shown in the machine's cab on an onboard computer display. The GPS grade control systems is precise to approximately 30 mm (0.1 feet) and enables the operators to perform bulk earthmoving without grade stakes and the necessity of a fulltime, onsite surveyor.

Layout, Inspection, and Documentation of Construction Features
To perform layout, inspection, and construction documentation for certain features, Wilder utilized a GPS receiver with a display mounted on a telescopic pole, or rover. The rover enabled construction personnel to perform feature layout and documentation without the necessity of a fulltime on-site surveyor. This also enabled E&E QA personnel to inspect construction features as they were being constructed (e.g., to check for proper location and elevation). To layout or inspect a feature, the rover was positioned over the design or as-built location of the feature, plumbed vertically with an attached bubble level, then triggered to take a measurement. The rover display shows the current X, Y, and Z coordinates; and through manipulation of the preloaded computer-generated surfaces (i.e., developed from the design drawings), shows what the coordinates and elevation of the feature should be. To capture the coordinates for record drawing or documentation purposes, a fix measurement is taken, and the captured data is assigned a unique name. See Section 2.7.4 for additional information related to the Record Drawings.

2.3.2 Impermeable Cap Construction
The impermeable portion of the upland cap covers an area of approximately 14.7 acres. The constructed cap footprint extends to the existing subsurface barrier wall on the northern, eastern, and southern sides and to the riparian zone limit along the river top-of-bank on the western side (see Record Drawings, Appendix K).

Per design, the impermeable cap was constructed of the following layers (listed in order from bottom to top): reworked and recompacted subgrade; sand leveling layer; geomembrane liner; geocomposite; sand drainage layer; biotic barrier layer (4-inch minus rock); geotexile filter; and vegetated topsoil layer (see Figure 2-1). Other features of the impermeable cap include gas vents and a subsurface stormwater management system consisting of perforated piping with cleanouts; double-contained conveyance piping; manholes; and a discharge outfall.

The purpose of the impermeable cap is to reduce the infiltration of storm water into the soils and groundwater contained within the barrier wall. This reduction is accomplished by evapotranspiration from the vegetated surface layer and by the collection of water that infiltrates below the surface layer with subsequent conveyance and discharge of the collected water outside of the barrier wall area (discussed further below). In addition, surface water runoff is routed away from the impermeable cap area by the sloped topsoil layer, which directs the water away from the barrier wall area toward a drainage swale. The water is then routed to an onsite retention/infiltration pond (with a sand bottom and rock spillway).

Water that infiltrates below the topsoil surface is collected and conveyed by gravity from within the sand drainage layer to the Willamette River via the subsurface stormwater management system. Water percolating through the drainage layer is directed laterally by gravity (i.e., sloped surfaces) atop the impermeable geomembrane through the overlying geocomposite to a network of perforated collection piping. Water within the perforated piping is then directed by gravity to a series of collection sumps, designated as manholes. The water collected in the manholes then flows within smooth-walled HDPE conveyance piping (located at depths below the geomembrane) from one manhole to the next downstream manhole in the series and is eventually discharged outside of the barrier wall to the river via a discharge outfall. Within the barrier wall, the conveyance piping is double-contained to minimize the possibility of the collected water from leaking into the subsurface and the possibility of contaminates entering the system and being conveyed to the river.

Construction details for each cap layer and feature are discussed in the following sections.

2.3.2.1 Subgrade

The purposes of the subgrade preparation activities were to reshape the cap subgrade material to the desired elevations and grades by both cutting and filling operations; provide a firm base that is free of objects that could damage the cap liner materials; and condition the subgrade materials for support of the various components of the site cap.

2.3.2.1.1 Materials and Equipment

Subgrade elevation contours were designed to balance cut and fill of existing site soils. Therefore, import of soil materials to achieve specified subgrade elevations was not required. Wilder used typical earth moving equipment to excavate, move, reshape, and compact the existing soils to attain the desired subgrade surface. Equipment utilized included two A35D Volvo dump trucks, two 623B CAT scrapers, a CAT VHP grader, D6R CAT bull dozer, SD1000 Vibratory Roller, CS-563E CAT vibratory roller, 200CC Deere Excavator, 924G CAT IT, and a water truck. The CAT grader was equipped with Topcon grade control equipment that automatically adjusted the height and angle of the blade according to the design subgrade surface (see Section 2.3.1.3).

2.3.2.1.2 Execution

Subgrade construction activities took place from June 8th to approximately June 25th, 2005. Within the impermeable cap, subgrade contours were designed and constructed to have peaks and valleys with required slopes so that water collected on the overlying geomembrane (see Section 2.3.2.3) will drain to the perforated collection piping system and manholes (see Section 2.3.2.9). To construct the subgrade, existing site soils were cut from certain areas and added (i.e., filled) to others. The amount of cut and fill was balanced during the design phase to avoid having a shortage or excess of material. For areas that did not require a significant amount of excavation, Wilder utilized the CAT grader and CAT dozer to roughly cut the material, then utilized the CAT grader to bring the surface to design grade. The scraper would then pick up the cut material and transport it to an area that required fill. At areas requiring substantial excavation to reach subgrade (e.g., the retention pond), Wilder utilized the 200CC excavator and 924G IT to excavate the material, then used the Volvo dump trucks to transport the material to impermeable cap fill locations. After fill material was placed, the SD1000 vibratory roller was immediately used to compact each lift of fill placed. The CAT grader was then used to obtain the required grade and a final pass was made with the roller for compaction. The water truck was used to add moisture to the soil prior to the material being compacted, as necessary.

To prevent puncturing of the overlying geomembrane, sharp objects and loose stones having a dimension greater than four inches that were brought to the surface during subgrade preparation were removed and placed outside the footprint of the impermeable cap area.

Following construction of the subgrade, Wilder's subcontractor, Northwest (NW) Geotech, performed compaction testing of the completed surface. Per design specifications, compaction testing was performed every 5,000 square feet (sf) and was required to be more than or equal to 95% maximum dry density. To ensure testing was done at the correct frequency, Wilder developed a grid with cell increments of 5,000 sf, superimposed it on an outline of the site, and downloaded it into the Topcon survey control system. Using the Topcon system, Wilder staked out the grid cell locations for NW Geotech to follow. Results of the compaction testing were referenced to the grid location. NW Geotech performed in-place compaction testing using a nuclear gage per ASTM D2922. Prior to performing compaction testing, NW Geotech collected nine soil samples to develop proctors, per ASTM D698. Since the existing site soils were made up of several different combinations of soil, multiple proctors had to be developed. When performing compaction testing, NW Geotech used the samples collected for the proctors to visually compare to the soil in the area being tested to determine which proctor to use for each test.

Copies of the subgrade compaction test results are included in Appendix D. Most tested areas passed the required 95% compaction criteria. If areas did not pass, Wilder tilled the area, added moisture (as necessary), recompacted, and then the area was retested by NW Geotech. A few areas of the impermeable cap footprint did not pass compaction testing even after reasonable recompaction effort by Wilder. In these instances, E&E field engineers made a visual inspection and accepted the results based on adequate effort being applied.

2.3.2.1.3 Quality Control/Quality Assurance

During subgrade construction activities, Wilder performed quality control utilizing their Topcon grade control system to verify lines and grades and to verify compaction testing frequency. E&E observed that the material was placed in proper lift thicknesses, moisture was added when needed, and the material was compacted soon after placement. Prior to installation of subsequent layers, E&E performed visual inspections of the surface conditions to ensure all objectionable materials were removed. If areas of concern were noted, Wilder was notified, and the area was re-inspected once materials were removed. E&E also reviewed compaction test results to ensure the frequency and results were in compliance with the design specifications. The test results were included as part of the Placement Verification Forms, which were required to be submitted by Wilder after completion of each cap layer. Copies of the Placement Verification Forms with associated compaction test results of the subgrade are included in Appendix D. Topographic data and/or maps were also required to be submitted by Wilder with the Placement Verfication Forms for verification that subgrade design elevations were attained. However, because of strict project timelines, Wilder was allowed to continue with construction of subsequent layers (i.e., sand leveling layer) prior to E&E receiving and approving topographic survey data from their surveying subcontractor, DEA. Wilder was informed that they were proceeding at their own risk if survey information indicated the subgrade topography was not correct. After receiving survey data from DEA, E&E reviewed the grades to verify results were in compliance with the design drawings. Copies of the Record Drawings showing as-built subgrade topography are included in Appendix K.

2.3.2.2 Sand Leveling Layer

The purposes of the sand leveling layer are to achieve the final elevations and grades for the subsequent geosynthetic layers (i.e., geomembrane and geocomposite); and to provide an uncontaminated working surface that is free of objectional materials that could damage the overlying geosynthetics. The leveling layer also functions as part of the cap's passive gas venting system.

2.3.2.2.1 Materials and Equipment

Sand used for the leveling layer was supplied by Ross Island Sand & Gravel (RISG), obtained from a quarry located near Avery, Washington.

RISG barged the sand to the site, then utilized a crane with a clam shell bucket, hopper, and belt conveyor to transport the sand from the barge to the upland offload area on the adjacent Metro property (located immediately downstream of the site). Wilder utilized two A35D Volvo dump trucks, a Komatsu loader, D6R CAT Dozer, D6N CAT Dozer, and a 924G CAT IT to transport the sand from the offloading area and to place the sand over the impermeable cap footprint atop the previously constructed subgrade.

2.3.2.2.2 Execution

Sand leveling layer construction occurred from June 27th to June 30th, 2005. As described above, sand was transported to the offloading area on the adjacent Metro property by barge. Once at the offloading area, the sand was conveyed from the barge to shore utilizing a crane and conveyor system. After allowing the sand to accumulate on shore, Wilder used the Komastu loader to load the stockpiled sand into dump trucks which would then transport the sand to the site. A haul road constructed of imported crushed rock was used for transport of the material to/from the cap area to prevent offsite tracking of site soils. The sand was dumped directly atop the prepared subgrade surface within the impermeable cap area and was then roughly spread to a depth of four inches utilizing the CAT Dozer. The CAT grader (equipped with the Topcon grade control system) was then utilized to make final adjustments to the grade. As the sand was being placed/spread, a water truck was used to add moisture, as necessary. Wilder commenced placement in the northeast corner of the impermeable cap footprint, worked their way west towards the riverbank, and then south.

Following construction of the sand leveling layer, NW Geotech performed in-place compaction testing of the completed surface using a nuclear gage per ASTM D2922. Per design specifications, compaction testing was performed every 5,000 sf and was required to be more than or equal to 92% maximum dry density per ASTM D698. NW Geotech utilized the same grid system set up for the subgrade to determine test locations. Results of the compaction testing were referenced to the grid location.

Copies of the leveling layer compaction test results are included in Appendix D. Most areas tested passed the required 92% compaction criteria. If areas did not initially pass, Wilder added moisture (as necessary), recompacted, and then the area was retested by NW Geotech. This process was repeated until all areas passed.

2.3.2.2.3 Quality Control/Quality Assurance

Prior to sand being delivered to the site, material specifications were submitted for approval by E&E, including sieve analysis and permeability test results. These analyses confirmed that the proposed sand material was in conformance with the design specifications. Copies of the test results are included in Appendix E. In addition, the sand material was inspected at the source facility (i.e., Avery

Quarry) by E&E's geotechnical engineering subcontractor, PacRim Geotechnical. A copy of the geotechnical report is included in Appendix E. Because the soil originated from the overburden of a sand and gravel quarry located in a pristine portion of the Columbia River Gorge, in an area of no former industrial uses and limited agricultural uses, DEQ concluded that chemical analysis of the soil was not necessary.

During leveling layer construction, Wilder utilized the Topcon GPS positioning system and automated grade control to verify lines and grades and to verify compaction testing frequency. E&E observed that the material was placed to a depth of approximately four inches, moisture was added when needed, and the material was compacted soon after placement. E&E also observed sand loading and placement/spreading operations to ensure no mixing of native soil was occurring and to ensure objectionable materials weren't present that could damage the overlying geomembrane layer.

E&E also reviewed compaction test results to ensure the frequency and results were in compliance with the design specifications. The test results were included as part of the Placement Verification Forms, which were submitted by Wilder after construction completion of the sand layer. Copies of the Placement Verification Forms with associated compaction test results are included in Appendix D. Prior to placement of the overlying geomembrane, a topographic survey of the leveling layer was performed by DEA. Computer-generated contour maps, however, were not submitted to E&E for review and approval until portions of the geomembrane were installed. Because of strict project timelines, Wilder was allowed to continue with installation of the overlying geomembrane layer prior to E&E's approval of the leveling layer topography from DEA. Wilder was, again, informed that they were proceeding at their own risk. On one occasion, Wilder was required to remove the overlying geomembrane to allow placement of additional sand in order to attain the required grades. Based on visual observations made by E&E, it appeared that the slope leading from the north edge of the cap (near the anchor trench) toward the cap interior was below the required two percent grade. This was subsequently confirmed with the Topcon GPS rover. Wilder was, therefore, required to remove the geomembrane and place additional sand along the cap's edge to ensure the required slope toward the cap interior was met. Following this incident, Wilder checked for the required two-percent slope along all remaining cap edges and made any necessary adjustments before the geomembrane was installed.

Copies of the Record Drawings showing as-built leveling layer topography are included in Appendix K. Note, the DEA survey from which the Record Drawings were generated was performed prior to placement of the additional sand along the north edge of the cap; therefore, the Record Drawings do not accurately reflect the as-built elevations of the sand leveling layer in this area. A similar note has been added on the corresponding Record Drawing.

2.3.2.3 Geomembrane

The purpose of the geomembrane is to serve as the primary component of the cap's low permeability liner system within the barrier wall area. The geomembrane liner functions as the hydraulic barrier that will maximize the removal of water by the overlying drainage layer and minimize infiltration of water through the cover system.

2.3.2.3.1 Materials and Equipment

Northwest Linings (NWL) supplied and installed the geomembrane. Forty-one (41) rolls of smooth 40 mil HDPE Liner and 27 boxes of HDPE welding rod manufactured by Poly-Flex, Inc., of Grand Prairie, Texas, were delivered to the site and used during the installation of the impermeable cap. Individual rolls measured 23 feet wide by 750 feet long. Materials were stored on large sheet metal panels near the north end of the impermeable cap area to allow for easy access during installation.

To construct the anchor trench for the geomembrane and geocomposite, Wilder utilized a 200CC Deere Excavator. NWL utilized a SD1000 vibratory roller and a VR-843 Highlift (with spreader bar) to deploy the liner materials. Equipment used during the welding of the geomembrane included: two Wedge It 2000 Series wedge welders; two extrusion welding guns; two generators; propane torches; grinders; and heat tackers (hot air guns). Equipment used during the testing of the geomembrane welds included: a tensiometer; vacuum box; air compressor; propane torches; vice grips; razor knifes; hollow needles with air pressure gauges; and a bicycle tire pump. NWL also utilized a gator ATV for transporting equipment.

To install boots around penetrations in the geomembrane, NWL used Manus-Bond All Purpose 501-A Butyl Sealant, and various lengths of metal clamps and neoprene gaskets depending on the diameter of the penetration. Sand bags were also used to temporarily anchor the geomembrane during installation.

2.3.2.3.2 Execution

Geomembrane installation occurred from July 5th to July 28th, 2005.

Deployment of Material

Prior to geomembrane deployment, an anchor trench was excavated around the impermeable cap perimeter to a depth of approximately two feet. Spoils from the trench were placed outside the impermeable cap footprint, where they were later used to fill the trench once the geomembrane and geocomposite were installed.

Before placing geomembrane panels, NWL inspected the underlying sand leveling layer surface and provided written approval (i.e., Certificate of Acceptance) that the subsurface on which the geomembrane was to be installed was acceptable (e.g., clean, firm, free of sharp objects, etc.). To install the geomembrane panels, NWL moved rolls into position using the highlift equipped with a spreader bar. Once in position, approximately forty feet of liner was unrolled and folded back over onto itself. A clamp was attached to the folded end of the liner and fastened to the SD1000 roller. With the highlift anchoring the roll, the roller was driven to the opposite edge of the cap footprint to deploy the material. The roller also served to smooth out the sand leveling layer as the roll was being deployed. If the sand layer was too dry, Wilder used the water truck to add moisture before the liner was deployed. Once at the other end, the clamp was removed and adjustments to the panel placement were made by hand. Adjustments included removing wrinkles and ensuring the panels were overlapped by four inches along their length and at the butt seams. Hand adjustment typically required five to six laborers. Once a panel was in place, sand bags were lined along its edge to prevent wind uplift. Enough material was left at each end of the panel so it could be secured in the anchor trench.

A total of ninety-six panels (cut from forty complete rolls and one partial roll) were used to construct the cap. The following information was recorded on each panel: roll number from which the panel came; designated panel number; date and time; and panel length. Panels were generally installed by unrolling the geomembrane east to west and then by laying panels adjacent to each other moving towards the south (see Appendix K for as-built geomembrane layout drawing prepared by NWL). The first roll was installed along the north edge of the cap area and measured approximately 650 feet in length. This initial panel spanned the width of the cap area and was designated as P1. NWL then used the remaining 100 feet of the roll to begin the adjacent row of panels, which was designated as P2. This pattern was continued throughout the installation of the geomembrane, which reduced the amount of small unusable scraps from partial rolls of material. This method also resulted in varying panel lengths with staggered seams.

Booting

Penetrations through the geomembrane were necessary at manhole, monitoring well, and gas vent locations. At these locations, either a notch or hole was cut in the membrane, and an HDPE boot was installed around each penetration. To install a boot, NWL wrapped the penetration with a band of geomembrane liner material and then field-fabricated an apron that could be welded to the band and to the geomembrane panel surrounding the penetration. This created a seal along the bottom of the boot. To seal the top of the boot, NWL wrapped the top circumference of the band with a strip of neoprene then fastened it with adjustable metal clamps. After the neoprene was installed, butyl sealant was used to create a seal between the neoprene and the surface of the penetration.

Welding

Two methods of welding were performed during the installation of the geomembrane liner: fusion welding and extrusion welding. Fusion welding was used to join the panels length-wise and along the butt seams. Extrusion welding was used to weld boots for penetrations, patches for destructive testing, and to patch any defects that occurred during fusion welding.

Test seams for both methods of welding were required at the start of each day when welding was performed and at five-hour increments thereafter, or when changes in the weather occurred. Test seams were made using the same materials and under the same conditions as field seaming. Samples were cut from each test seam and tested on the tensiometer for peel and shear strength. Once the test seams passed (per ASTM D6392), the welding operators were allowed to begin field seam welding.

During fusion welding of adjacent panels, the overlap of the two panels was carefully fed into the self-propelled wedge welder. A sheet of spare geomembrane material was inserted under the overlapping panels to create a “sled” that would prevent the underlying leveling sand from entering the welds. The “sled” was attached to a strap so that it could be pulled along as the wedge moved down the seam. As the wedge moved along the seam, the operator and assistant ensured that the seam was free of sand and moisture by wiping the overlapping panels with towels and by moving the sled ahead of the wedge. The operator also monitored the wedge alignment to ensure the correct amount of overlap existed and adjusted the path of the wedge if any problems arose. Butt seams were welded prior to intersecting panel seams. The self-propelled wedge created two welds (inside and outside) separated by a half-inch channel, which allowed for air pressure testing once the seam was completed (see below).

Extrusion welding was used for repairs made to the liner system and for welding boots around liner penetrations. Repairs were necessary because of destructive testing, air pressure testing, punctures to the liner, and defects during fusion welding. To prepare an area for extrusion welding, NWL cut an appropriately sized piece of geomembrane from scraps to serve as a patch. The patch was heat-tacked into place and the edges of the patch and the surrounding panel was grinded to create a roughened surface. NWL then used an extrusion weld gun to weld the patch into place with HDPE extrudate. After patching was completed, the extrusion welds were vacuum tested to ensure an impermeable seal was created (see below).

2.3.2.3.3 Quality Control/Quality Assurance

Precertifications and Conformance Testing

Prior to geomembrane rolls being delivered to the site, material precertifications were submitted by the manufacturer (Poly-Flex) through Wilder. E&E reviewed the precertifications to verify that the manufactured rolls conformed with the design specifications. As rolls of geomembrane were subsequently delivered to the site, E&E verified that the delivered roll numbers corresponded to the roll numbers submitted in the precertifications.

Conformance testing of the geomembrane material was also performed by an independent laboratory, TRI Environmental, Inc, of Austin, Texas. Samples were collected at a frequency of one per 100,000 sf (or one per lot) from the manufactured rolls and tested for the following:

- Thickness per ASTM D5199;
- Tensile properties per ASTM D638/GRI GM 13;
- Puncture resistance per ASTM D4833; and
- Tear resistance per ASTM D1004.

E&E reviewed the test results to verify conformance with design specifications. Copies of the test results submitted by TRI Environmental are on file at the DEQ and E&E offices in Portland (submittal numbers 017 and 023).

Seam Testing

Non-destructive and destructive testing methods were used to determine if the constructed seams met specifications for peel and shear strength.

The primary method of non-destructive testing was air pressure testing. During air pressure testing, the half-inch channel created by the wedge was filled with air to a pressure of 25-30 psi and was required to vary no more than four psi in a five-minute span. To fill the channel with air, tabs were cut at either end of a continuous stretch of seam. Using a propane torch the ends of the tabs were heated and then sealed by pinching them together with vice-grips. A hollow needle with a pressure gage was then inserted at one end of the seam, and the seam was filled with air using a bicycle pump. Once the seam passed test requirements, the end of seam opposite where the needle was located was cut to release the air. The opposite end was cut to show that air could pass through the entire seam and there was no blockage present. Following pressure testing, the resulting holes created by the tabs were patched using extrusion welding. All seams, including butt seams, were tested by air pressure testing.

If a seam lost more than four psi in five minutes, the source of the leak was identified by visual inspection, audio inspection, or by cutting the seam in half and narrowing down the location of the leak. Once a leak was identified, the continuous seam on either side was tested and the leak was marked to be repaired by extrusion welding a patch. Leaks also occurred if the end tabs were not properly sealed or if the needle allowed air to escape from around it. Occasionally, seams popped during air pressure testing. In these cases, the location of the breach was identified and the leak was repaired.

Since extrusion welding does not produce a channel that can be air pressure tested, patches installed by extrusion welding were non-destructively tested via vacuum testing. To perform vacuum testing, an air compressor, vacuum box with pressure gage and viewing window, and soapy water were used. Once a patch was completed, the weld was covered with soapy water, then the vacuum box was placed over the weld to create a vacuum over the weld. If a leak was present, the soapy water would bubble as air was pulled into the vacuum box. For a weld to pass, testing at a pressure of thirty psi in the vacuum box was required, and no bubbling could be present. Leaks were repaired by further extrusion welding, followed by additional vacuum testing until all welds passed.

Destructive testing was also used to test the seams for peel and shear strength. Frequency of testing was one test per 500 feet of installed seam (see Appendix K for as-built geomembrane layout drawing showing destructive testing locations). To collect the sample for destructive sampling, approximately eighteen inches of installed seam was cut from the liner. From this sample, ten coupons were cut and tested in the field using a tensiometer: 5 for peel and 5 for shear strength per ASTM D6392. Four out of the five coupon samples were required to pass testing in order for the sample to pass field destructive testing. In addition, one out of every five destructive tests that passed field testing was sent to TRI Environmental for independent laboratory verification. If a destructive test failed laboratory testing, additional samples were collected 15 feet from either side of the original sample and tested. This was repeated until two passing samples were located. The seam bounded by the two passing samples was then patched, reinforced by extrusion welding, and vacuum tested for its entire length. A total of fifty-eight destructive tests were performed during the installation of the liner. Three destructive tests failed laboratory testing and required additional testing.

Additional QA Activities Performed

During panel deployment, E&E verified that the proper seam overlap was attained between adjacent panels and that panels were given proper identification codes. During seaming/welding activities, E&E inspected the seams and panels for damage and observed that seam testing was being performed and results were properly recorded. Boot installations were also observed to ensure the proper materials and procedures were followed to create a tight seal around each penetration.

E&E also recorded seam test results independently of NW Linings and ensured destructive test samples were taken at the required frequency. In addition, E&E

mapped each seam to show overall seam lengths, repair areas, approximate distances between repair areas, results of air pressure and vacuum testing, and destructive test locations. These seam maps were used in the field to ensure that all seams and patches were properly tested and to document if repairs were necessary due to testing or were the result of welding errors. Wilder also used their Topcon GPS system to survey the repair area locations.

Reports and Forms

NWL completed reports and forms throughout geomembrane construction to document performance of QC/QA activities. Reports and forms submitted to E&E (through Wilder) included: subgrade acceptance, daily progress reports, panel placement, test welds, panel seaming, non-destructive testing, repair reports, destructive testing, and daily panel layout. E&E reviewed NWL's paperwork for accuracy and completeness. Copies of the forms, reports, and tests submitted by NWL are on file at the DEQ and E&E offices in Portland (submittal number 027).

2.3.2.4 Geocomposite

The geocomposite drainage layer was installed atop the geomembrane layer. The purpose of the geocomposite is to collect stormwater that infiltrates through the cover soil layers and convey the water to the network of perforated collection piping and manholes (see Section 2.3.2.9).

2.3.2.4.1 Materials and Equipment

NWL supplied and installed the geomembrane. Two-hundred-sixty-nine (269) rolls of Poly-Flex Double Sided 8oz Geocomposite with 200 mil Geonet were delivered to the site. Of this total, 25 rolls were not used. Individual rolls measured 13.5 feet wide by 200 feet long. Zip-ties and sandbags were used to fasten adjacent geocomposite panels together and to prevent wind uplift, respectively.

NWL utilized a VR-843 highlift with spreader bar and an ATV gator vehicle to deploy the geocomposite panels. Other equipment used for installation of the geocomposite included heat tackers (hot air guns), razor knives, generators, and propane torches.

2.3.2.4.2 Execution

Geocomposite installation occurred from July 15th to July 29th, 2005.

Prior to deployment of the geocomposite material, all debris was removed from the surface of the geomembrane that may prevent the geocomposite flow paths from becoming blocked. NWL deployed the geocomposite panels in a manner similar as the geomembrane, using a highlift with spreader bar to position the geocomposite rolls for deployment. Once in position, approximately fifteen feet of material was unrolled, and a handle was cut into the material centered at the end. NWL then used a strap tied through the handle to fasten the geocomposite to the back of the ATV gator vehicle. With the highlift anchoring the rolls at one end, the gator was driven to the opposite edge to deploy the geocomposite roll. Panels were adjusted by hand to reduce the number of wrinkles and to ensure adjacent rolls and butt seams were overlapped by at least four inches.

Wind up-lift was prevented by placing sand bags along the exposed edges of the geocomposite. Zip-ties were used to secure the geonet of adjacent panels together at intervals of five feet. Along the butt seams, the geonet was secured at intervals of six inches. All overlapping geotexile and butt seams were sealed to prevent the subsequent overlying sand layer from blocking the geonet water conveyance matrix. Once the geonet of adjacent panels had been secured together, the overlapping geotexile fabric from the panels was heat tacked together using propane torches or heat tackers. Strips of excess geotexile fabric were also placed over the butt seams and heat tacked into place.

Geocomposite material was unrolled east to west, and panels were laid adjacent to each other north to south. Sufficient material was left at the end of each panel so that the geocomposite could be secured into the anchor trench. Once the geocomposite material was placed, the anchor trench was backfilled.

2.3.2.4.3 Quality Control/Quality Assurance

Prior to geocomposite rolls being delivered to the site, material precertifications were submitted by the manufacturer (Poly-Flex) through Wilder. E&E reviewed the precertifications to verify that the manufactured rolls conformed with the design specifications. As rolls of geocomposite were subsequently delivered to the site, E&E verified that the delivered roll numbers corresponded to the roll numbers submitted in the precertifications.

Conformance testing of the geocomposite material was also performed by an independent laboratory, TRI Environmental. Samples were collected at a frequency of one per 100,000 sf (or one per lot) from the manufactured rolls and tested for the following:

- Thickness per ASTM D5199;
- Mass per Unit Area per ASTM D5261;
- Density per ASTM D1505; and
- Hydraulic Transmissivity per ASTM D4716.

E&E reviewed the test results to verify conformance with design specifications.

During deployment of the geocomposite, E&E observed that no damage was caused to the underlying geomembrane and that proper overlap of adjacent geocomposite panels was maintained. E&E also visually inspected fastening of the geonet to ensure proper zip-tie spacing of the adjacent and butt seams. Each panel placed was also visually inspected by E&E for damage and/or defects.

Damage found during inspections included factory defects and holes burned through the top geotexile resulting from heat tacking the overlapping fabric. NWL was made aware of the damaged areas, after which the areas were repaired (i.e., patched) and re-inspected.

2.3.2.5 Sand Drainage Layer

The purposes of the sand drainage layer are to serve as a component of the impermeable cap's subsurface drainage system; to help protect the underlying geosynthetic materials from damage (e.g., from construction and maintenance vehicles); and to achieve the required slopes for final grade.

2.3.2.5.1 Materials and Equipment

Sand used for the drainage layer was supplied by Ross Island Sand & Gravel (RISG), obtained from a quarry located near Avery, Washington.

RISG barged the sand to the site, then utilized a crane with a clam shell bucket, hopper, and belt conveyor to transport the sand from the barge to the upland offload area on the adjacent Metro property. Wilder utilized two A35D Volvo dump trucks, a Komatsu loader, D6R CAT Dozer, D6N CAT Dozer, and a 924G CAT IT to transport the sand from the offloading area and to place the sand over the impermeable cap footprint atop the previously installed geocomposite.

2.3.2.5.2 Execution

Drainage sand layer construction occurred from July 15th to August 18th, 2005. As described above, sand was transported to the offloading area on the adjacent Metro property by barge. Once at the offloading area, the sand was conveyed from the barge to shore utilizing a crane and conveyor system. After allowing the sand to accumulate on shore, Wilder used the Komastu loader to load the stockpiled sand into dump trucks, which would then transport the sand to the site. A haul road constructed of imported crushed rock was used for transport of the material to/from the cap area to prevent offsite tracking of site soils. For truck access, dumping, and spreading over the impermeable cap area, a minimum haul road thickness of 30-inches of material over the geosynthetics was maintained. The sand was dumped directly atop the geocomposite surface and was then roughly spread to the approximate required depths utilizing the CAT Dozer. The first lift (placed directly atop the geocomposite) was spread with a low ground pressure dozer to a minimum depth of 10 inches. While the dozer was pushing the sand over the geocomposite, Wilder personal stood in front of the push-out to help prevent the formation of wrinkles in the geocomposite layer. Placement of sand around the perforated collection piping system (see Section 2.3.2.9) was done with the 200CC excavator to ensure the collection piping was not disturbed or damaged. Following rough placement of the sand, the CAT grader (equipped with the Topcon grade control system) was then utilized for fine grading until final grade was achieved. Depending on location within the cap footprint, final sand thickness varied from approximately 10 inches to 60 inches.

Following construction of the sand drainage layer, NW Geotech performed in-place compaction testing of the completed surface using a nuclear gage per ASTM D2922. Per design specifications, compaction testing was performed every 5,000 sf and was required to be more than or equal to 90% maximum dry density per ASTM D698. NW Geotech utilized the same grid system set up by Wilder for the subgrade to determine test locations and frequency. Results of the compaction testing were referenced to the grid location.

Copies of the drainage layer compaction test results are included in Appendix D. Most areas tested passed the required 90% maximum dry density compaction criteria. If areas did not initially pass, Wilder added moisture (as necessary), recompacted, and then the area was retested by NW Geotech. This process was repeated until 90% density was attained.

2.3.2.5.3 Quality Control/Quality Assurance

Prior to sand being delivered to the site, material specifications were submitted for approval by E&E, including sieve analysis and permeability test results. These analyses confirmed that the proposed sand material was in conformance with the design specifications. Copies of the test results are included in Appendix E. In addition, the sand material was inspected at the source facility (i.e., Avery Quarry) by E&E's geotechnical engineering subcontractor, PacRim Geotechnical. A copy of the geotechnical report is included in Appendix E. Because the sand originated from a sand and gravel quarry located in a pristine portion of the Columbia River Gorge, in an area of no former industrial uses and limited agricultural uses, DEQ concluded that chemical analysis of the sand was not necessary

During leveling layer construction, Wilder utilized the Topcon GPS positioning system and automated grade control to verify lines and grades and to verify compaction testing frequency. E&E observed that the material was placed to appropriate depths (e.g., initial lift of 10 inches minimum), moisture was added when needed, and the material was compacted soon after placement. E&E also observed sand loading operations to ensure no mixing of native soil was occurring and observed sand placement/spreading to ensure the underlying geosynthetics and collection piping were not damaged.

E&E also reviewed compaction test results to ensure the frequency and results were in compliance with the design specifications. The test results were included as part of the Placement Verification Forms, which were submitted by Wilder after construction completion of the drainage layer. Copies of the Placement Verification Forms with associated compaction test results are included in Appendix D. Prior to placement of the overlying biotic layer, a topographic survey of the sand drainage layer was performed by DEA. Computer-generated contour maps were submitted to E&E for review and approval. Copies of the

Record Drawings showing as-built drainage sand layer topography are included in Appendix K.

2.3.2.6 Biotic Barrier Layer

The purposes of the biotic barrier layer are to minimize the potential for burrowing animals and/or plant roots from penetrating, damaging, or interfering with the underlying drainage and hydraulic barrier layers; to create a capillary break to improve water retention within the overlying topsoil layer; and to serve as an upper component of the cap drainage layer.

2.3.2.6.1 Materials and Equipment

The biotic barrier layer consists of a 6-inch thick layer of 4-inch minus rock. The rock was supplied via truck from Morse Brothers, Inc., obtained from the Angell Quarry located by Linnton, Oregon.

Wilder used typical earth moving equipment to perform rough and finish grading of the biotic rock layer. Two LGP bulldozers, a D6R, and a D6N manufactured by CAT, were utilized for the biotic barrier layer construction. Both were equipped with the Topcon automated grade control equipment (see Section 2.3.1.3).

2.3.2.6.2 Execution

Biotic rock layer construction activities took place form July 29th to August 16th, 2005. Rock for the biotic barrier layer was delivered to the site by truck and dumped directly on the sand drainage layer within the barrier wall near where it was required. For truck access, dumping, and spreading over the liner a minimum haul road thickness of 30-inches of material over the geomembrane was maintained. Initial spreading and rough grading occurred as the rock was delivered. Finish grading was accomplished when possible between deliveries.

2.3.2.6.3 Quality Control/Quality Assurance

Prior to biotic rock delivery, E&E designated a geotechnical engineering firm, PacRim Geotechnical, to visually inspect the proposed rock at its source. The geotechnical engineer inspected it for size, hardness, durability, shape, porosity, and the presence of deleterious material. Approval of the rock was based on the geotechnical engineer's findings and on visual inspection of each load delivered to the site. A copy of the geotechnical report is included in Appendix E.

During biotic layer construction, Wilder utilized the Topcon GPS positioning system and automated grade control to verify lines and grades. Prior to placement of the overlying geotextile filter layer, a topographic survey was performed by DEA. Computer-generated contour maps were submitted to E&E for review and approval. Copies of the Record Drawings showing as-built drainage sand layer topography are included in Appendix K.

As an additional quality control measure, Wilder used tall traffic cones as visual indicators for the protection of constructed features such as perforated collection piping cleanouts, monitoring wells, and gas vents.

During placement of the biotic barrier layer material, E&E CQA personnel observed and ensured that:

- Wilder used only low ground pressure (LGP) construction equipment, and that temporary haul roads on the site cap were constructed to a minimum of 30 inches;
- The biotic barrier layer rock delivered to the site was properly sized and free of deleterious and objectionable material that could damage the underlying geosynthetic liner and drainage materials; and
- Equipment operators did not perform pivot turns or any other operating practices which could cause damage to or shifting of the underlying geosynthetic materials and/or drainage piping.

2.3.2.7 Geotextile Filter Layer

The purpose of the geotextile filter layer is to serve as a separation and filter layer between the coarse biotic layer material and the overlying finer-grained topsoil material.

2.3.2.7.1 Materials and Equipment

Geotexile material was manufactured by SI Geosolutions of Chattenooga, Tennessee, and supplied by NWL.   Approximately 145 rolls of Geotex® 801 were delivered to the site. Individual rolls measured 12.5 feet wide by 100 yards long.

Installation of the geotextile was performed by Wilder. A Komatsu loader was used to stage the geotextile rolls, and a CAT 924G IT with a spreader bar was used for roll deployment. A propane torch was also utilized to heat-tack the seams together, and sand bags were used to prevent wind uplift.

2.3.2.7.2 Execution

Geotextile installation occurred from August 5th to August 23rd. Wilder installed the geotexile in a pattern similar to the geomembrane and geocomposite (i.e., panels were laid east to west and then by laying panels adjacent to each other moving towards the south). Initially, Wilder used the Komatsu loader and 924G IT to stage the rolls in the area of installation then unrolled the geotexile by hand. Wilder later built a spreader bar for the 924G IT and unrolled the geotexile with the aid of this equipment. Sand bags were placed at the exposed edges of the panels to prevent wind uplift. Adjacent panels were overlapped by six inches and heat-tacked together with a propane torch along the entire length of the seam.

Any damaged areas of geotexile were repaired by heat tacking a patch of geotexile over the damaged area.

2.3.2.7.2 Quality Control/Quality Assurance
Prior to geotextile rolls being delivered to the site, material precertifications were submitted by the manufacturer (SI Geosolutions) through Wilder. E&E reviewed the precertifications to verify that the manufactured rolls conformed with the design specifications. As rolls of geotextile were subsequently delivered to the site, E&E verified that the delivered roll numbers corresponded to the roll numbers submitted in the precertifications.

Conformance testing of the geotextile material was also performed by an independent laboratory, TRI Environmental. Samples were collected at a frequency of one per 100,000 sf (or one per lot) from the manufactured rolls and tested for the following:

- Grab Tensile per ASTM D4632;
- Mass per Unit Area per ASTM D3776;
- Puncture Strength per ASTM D4833;
- Trapezoidal Tear per ASTM D4533; and
- Mullen Burst per ASTM D3786.

E&E reviewed the test results to verify conformance with design specifications. Note, two rolls of material delivered to the site did not pass conformance testing. These rolls were marked, set aside, and not used to construct the geotexile layer. TRI Environmental also tested the surrounding rolls for conformance and to isolate the problem. Results for the surrounding rolls were accepted by E&E.

During installation of the geotextile, E&E observed that proper overlap of adjacent panels was maintained. Each panel placed was also visually inspected by E&E for damage and/or defects. Damage found during inspections included holes burned through the geotexile resulting from heat-tacking the overlapping fabric. Wilder was made aware of the damaged areas, after which the areas were repaired (i.e., patched) and re-inspected.

2.3.2.8 Topsoil Layer
Within the barrier wall, the purpose of the vegetated topsoil layer is to help attenuate infiltration of precipitation to the underlying drainage layers and to help protect the underlying cap components from damage by surface traffic loads, erosion, and frost penetration. The topsoil layer also helps resist wind and water erosion and enhances the aesthetics of the capped area.

2.3.2.8.1 Materials and Equipment
Topsoil used for construction of the upland cap came from following three sources:

- The existing stockpile located along the southeastern edge of the property, which was previously imported by MBI from the Reichhold Quarry. This soil is generally classified as a loam (approximately 50% sand; 35% silt; and 15% clay) with cobbles. Chemical analysis was also performed on this soil to verify that the material does not contain any pollutants. A copy of the Technical Memorandum presenting the findings of this analysis is included in Appendix E (note, data validation memos are not included in the Appendix).
- Topsoil imported by barge by RISG from the Avery Pit. This soil is sandier in nature and is classified as a sandy loam (approximately 70% sand; 20% silt; and 10% clay). Texture Classification results are included in Appendix E. No chemical analysis was performed on this soil, as previously discussed.
- Topsoil trucked in from the Reichhold Quarry by MBI during construction. This soil is similar in texture classification as the existing stockpiled soil (i.e., loam with cobbles).

A map showing the approximate locations where each topsoil type was placed is included as Figure 2-2.

Equipment used to place the vegetative topsoil layer included a Komatsu Loader, two A35 Volvo dump trucks, a D6N and D6R CAT Dozer, and a CAT Grader. RISG used a barge to transport the soil to site and off loaded the soil using a hopper and conveyor set up on the adjacent Metro property.

2.3.2.8.2 Execution

Topsoil had been stockpiled on site from the Reichhold Quarry during previous construction activities. This topsoil was used primarily on the south end of the soil cap and the eastern edge outside of the barrier wall (see Figure 2-2). No topsoil from the existing stockpile was used to construct the impermeable cap topsoil layer. This area was constructed with topsoil imported from the Avery Pit by barge and with a topsoil mixture consisting of trucked material from the Reichhold Quarry and barged material from the Avery Pit (see Figure 2-2).

Wilder began placing topsoil over the impermeable cap on August 16th and completed topsoil placement on August 31st, 2005.

Topsoil that was imported by barge was off loaded using a hopper and conveyor belt system set up on the adjacent Metro property. Once offloaded from the barge, Wilder used a Komatsu loader to place the topsoil into the two A35 dump trucks. The dump trucks transported the topsoil to the site and placed it in the general area where the soil was to be spread. Topsoil imported by truck was directly dumped atop the area where it was to be spread. In both cases, after the topsoil was placed in a single lift, the CAT dozers were used to rough grade the soil, then the CAT grader (equipped with the Topcon grade control system) was utilized for fine grading until final grade was achieved. Depending on location within the impermeable cap footprint, the topsoil layer ranged in thickness from nine to twelve inches.

In order to achieve the required compaction of 75-85% maximum dry density, Wilder did not compact the topsoil after it had been placed. Low compaction was desired to provide favorable soil conditions for vegetation to grow. Once a section of topsoil had been brought to design grade, NW Geotech performed in-place compaction testing using a nuclear gage following ASTM D2922. Per design specifications, compaction testing was performed every 5,000 sf. NW Geotech used the same grid system developed by Wilder that was used for the subgrade, leveling sand layer, and drainage sand layer to determine the location and frequency of testing. Results for the compaction testing were referenced to the grid location. Copies of the compaction test results are included in Appendix D. After the topsoil passed compaction testing, it was hydroseeded according to the type of topsoil placed (see Section 2.3.4.3).

2.3.2.8.3 Quality Control/Quality Assurance

Prior to topsoil being delivered to the site, samples and material test results were submitted to E&E for approval, and a geotechnical engineer visually inspected the topsoil at its source. Copies of the test results and the geotechnical report are included in Appendix E. Topsoil obtained from the Reichhold Quarry was pre-approved for use at the site. Material samples from the Avery pit, however, did not meet contract requirements for gradation and pH. In order to compensate for the non-conformance to the contract specifications, Wilder was requested to amend the topsoil during hydroseed application (see Section 2.3.4.3).

During placement of the topsoil, Wilder was required to use low ground pressure equipment to protect the underlying layers and to achieve low compaction. After compaction test results were submitted, E&E reviewed the results to ensure proper frequency and compaction density requirements were obtained. Wilder used their Topcon grade control system to place the topsoil to the appropriate thickness, and DEA surveyed the layer at completion. Computer-generated contour maps were then submitted to E&E for review and approval. Areas requiring additional work to attain final design grades were identified by E&E, after which the areas were re-graded by Wilder until a satisfactory topographic survey was achieved.

Copies of the Record Drawings showing as-built topsoil layer final topography are included in Appendix K.

2.3.2.9 Stormwater Collection and Conveyance System

The purpose of the stormwater collection and conveyance system is to collect and convey the infiltrated stormwater (within the impermeable cap footprint) to the discharge outfall structure. This system consists of a network of perforated drainage piping which collects and conveys water collected atop the geomembrane, which is then conveyed through a series of manholes and piping to the outfall structure located outside of the barrier wall on the riverbank.

2.3.2.9.1 Materials and Equipment

The following materials were supplied by H.D. Fowler of Clackamas, Oregon:

- HDPE perforated pipe wrapped with filter sock for collection of stormwater atop the liner/geocomposite system. Make/model: Hancor Hi-Q®. Diameters: 6" and 8".
- HDPE smooth wall pipe (butt-fused) for conveyance of collected stormwater between manholes (inner pipe of double containment pipe system within the barrier wall). Make/model: WL Plastics Corp., High Country Fusion SDR 32.5 HDPE PE 3408. Diameters: 6", 8", and 10".
- HDPE corrugated pipe with smooth wall interior (bell-and-spigot joints) for double containment around HDPE smooth wall pipe and for conveyance of stormwater from manhole E to the outfall. Make/model: Hancor BLUE SEAL®. Diameters: 8", 10", and 12".
- Manholes A, B, C, and D made of corrugated HDPE pipe with pre-fabricated extrusion welded HDPE pipe stub insertions and bottom plates. Make/model: Hancor. Diameter: 48".
- Custom-fabricated galvanized ladders installed within the HDPE manholes.
- Cleanout riser vaults (for perforated pipes). Make/model: Carson Industries 1730-12 with L-bolt locks.

Hanson Pipe and Products, of Portland, Oregon, also supplied the following materials:

- 48" pre-cast concrete Keylock Manhole (Manhole E, located outside of the barrier wall).
- Precast concrete pads with frames and covers (for Manholes A, B, C, and D). Make/model of frame and cover: Olympic Foundry Surburban MH Ring and Cover, Part No. MH26 Cast Flush.
- Kor-N-Seal flexible pipe to manhole connector (for Manhole E).
- Manhole steps (for Manhole E). Make/model: M.A. Industries Inc., PS2-PF Manhole Step.

The outfall structure is constructed of cast-in-place concrete, supplied by Glacier Northwest. Backflow prevention during high water events is accomplished with a discharge check valve (Tideflex Series TF-1), installed on the end of the corrugated pipe at the outfall.

Equipment utilized during the installation of the stormwater system included a HDPE pipe fusion welder, air pressure testing equipment, a grade level laser, the

Topcon GPS positioning rover, shovels, a small plate compactor, SD 1000 vibratory Roller, and two John Deere Excavators (135C and 200CC).

2.3.2.9.2 Execution

Manholes

Installation of the manhole bases and risers occurred from June 8th to June 16th, 2005. At each designated manhole location, excavators were used to excavate to the design base elevation. Once proper grade was attained, the manhole was lowered into the excavation and set plumb. Manhole base elevations were then checked for conformance with design elevations. Once elevations were confirmed, the manholes were partially backfilled around the base (up to the conveyance pipe inlets) to prevent movement. Remaining backfilling around each manhole was deferred until installation of the piping between the manholes was completed. For manholes located within the impermeable cap (i.e., Manholes A, B, C, and D), previously excavated spoils were used for backfilling up to the sand leveling layer, after which backfilling was completed with the specified cap materials (e.g., leveling sand, drainage sand, biotic rock, and topsoil). Outside of the impermeable cap, the excavation around precast concrete Manhole E was backfilled with native spoils to two feet below final grade surface, after which backfilling was completed with imported topsoil. Backfill compaction was performed by tamping with the excavator bucket.

Manhole pads were temporarily set on manholes from August 29th to August 31st, 2005, and the ladders were installed from September 12th through September 15th, 2005. Precast concrete pads with covers were placed over the manholes. Ladders were attached to the underside in order to provide access into the manhole. Each ladder was custom made for its corresponding manhole (i.e. either A, B, C, or D). The ladders consist of three main components: the ladder, a supporting beam, and brackets for attachment to the precast concrete pad. In order to ensure proper bracket placement on the covers, Wilder created a template out of plywood. They laid the template on the cover and drilled 9/16” holes for attaching the brackets. After the holes were drilled, they were cleaned of debris and filled with Powers Fasteners AC55 Plus epoxy. The mounting brackets were then quickly secured to the cover before the epoxy could set. With the brackets in place, Wilder secured the ladder to one set of brackets and the support beams to the other set of brackets, then drilled holes through the galvanized steel and secured the ladder and support beams together. The area immediately surrounding the manholes was compacted using a jumping jack in order to provide a stable surface for the manholes covers to be installed. To account for the 6” thickness of the precast concrete pads, approximately 6” was cut from the top of each HDPE manhole riser prior to the pads being placed. To place the concrete pads with the attached ladders, Wilder used the 924G IT to raise the pads to an elevation where they could be inverted with enough clearance underneath for the ladders. Once inverted, the pads were placed over their respective manhole and lowered into place. Topsoil was then placed around the concrete pad until the top elevations matched surrounding grade.

Conveyance Piping
Installation of the conveyance piping occurred concurrently with the manhole bases and risers (from June 8th to June 16th). Trench excavation for the conveyance piping was accomplished using excavators and hand shovels. If over-excavation occurred, a small compaction tool was used to compact the disturbed soil and create a proper bedding surface. Once a segment of trench was excavated, the HDPE corrugated pipe (exterior pipe) was installed by sections. The corrugated pipe sections were secured together using their bell and spigot ends. At each joint, a gasket was installed into the bell end of one segment, and pipe grease was applied to the end of the other. The spigot end was then inserted into the bell end until it was secure. After the corrugated pipe segment passed pressure testing (see Section 2.3.3.3, below), the interior smooth-walled butt-fused HDPE piping was inserted. Adjacent to the pipe trench, forty-foot sections of the interior pipe were butt fused together to create lengths of pipe that corresponded to the pipe lengths between the manholes. The interior pipe was then inserted into the outer corrugated piping by securing a strap around the interior pipe and then fastening the strap to an excavator. The excavator was then used to slide the interior pipe into the outer pipe, and the pipe system was connected to the manholes at the pre-fabricated stub-outs. Within the HDPE manholes (Manholes A, B, C, and D), the annular space between the inner and outer pipes was later filled with a pre-cut ¼" thick HDPE ring ("wedding ring") that was extrusion welded to both pipes to create a watertight seal between the pipes within the manhole. Following air pressure testing of the interior pipe (see Section 2.3.3.3, below), backfilling around the conveyance piping was performed. Backfill material (i.e., previously excavated spoils) was manually worked into the pipe haunches using shovels. Backfill was placed by excavator and proceeded in lifts until the surface grade was matched. Compaction of the lifts was done by a plate compactor and final compaction was accomplished with a vibratory drum roller (SD 1000).

Outfall
Construction of the outfall structure occurred from June 15th to June 17th, 2005. The outfall was constructed using a standard cast-in-place method with plywood forms reinforced with dimensional lumber anchored in place with metal form stakes. The specified rebar schedule was followed, and concrete finishing was performed per the design. For slope protection, the bank downgradient from the outfall was covered with one lift of 12-inch minus rock.

Collection Piping
Following geomembrane and geocomposite installation (see Sections 2.3.2.3 and 2.3.2.4) installation of the perforated collection piping atop the geocomposite occurred. The collection piping was installed from approximately July 18th

through August 12th, 2005. Activities related to the installation were concurrent with the completion of the geocomposite installation and prior to the placement of the drainage sand layer. The perforated collection pipes were place in a network of graded valleys design to create flow towards the manholes. Cleanout of the perforated pipe is made possible by seven cleanout risers contain within bottomless plastic vaults. To allow drainage the cleanout risers are surrounded by a few inches of drainage rock.

2.3.2.9.3 Quality Control/Quality Assurance

Horizontal and vertical layout for the stormwater collection and conveyance components was accomplished by Wilder using the Topcon GPS positioning system. Grade control during trench excavation between manholes was maintained using a level laser. The GPS positioning system rover was also used periodically for random inspections and to ensure that individual components of the system were in conformance with the design elevations, lines, and grades.

At each manhole, the pre-fabricated pipe stub configurations and associated invert elevations were checked for conformance with the design. After the manholes were set, E&E determined that the Manholes A, B, and C were not configured correctly as supplied from the manufacturer. It appeared that Manhole A had correct perforation pipe configuration, but the conveyance pipe stub was not correct relative to the perforation pipe. Manhole B had two perforation pipe stubs and one conveyance, but should have had one perforation pipe and two conveyance pipes. Manhole C had the perforation pipe stub on the wrong side. Wilder was subsequently informed of these errors. The manholes were later modified in the field by subcontractor Fergusen Industrial Plastics by capping the improperly configured conveyance pipe stubs with extrusion-welded HDPE caps; cutting new inlets at the correct locations; and installing new extrusion-welded stubs. The improperly configured perforated pipe stubs on Manholes A and C were allowed to remain, since pipe deflection could be used to connect the piping to the manhole stubs.

After installation of each corrugated pipe section between manholes, the piping run was air pressure tested by Wilder per ASTM F1417. Sections that did not pass pressure testing were either repaired or replaced, as necessary, until passing results were observed by E&E’s CQA staff.

During fusion bonding of the smooth-wall HDPE piping, Wilder monitored and recorded fusion bonding heater plate surface temperatures and hydraulic cylinder interface pressures to ensure the manufacturer-specified optimum range of fusion conditions was maintained. Measurements were submitted to E&E CQA personnel for review and approval (submittal number 13). The butt-fused HDPE pipe was also air pressure tested per ASTM F1417 following insertion into the exterior corrugated pipe. All interior sections of piping passed testing.

Following connection of the piping segments to the manholes and installation of the “wedding rings”, the manholes were hydrostatically tested to check for leakage. An inflatable plug was inserted at the outlet from Manhole C to Manhole E, which allowed for the testing of Manholes A, B, and C. It was determined that Manhole C had the lowest elevation perforations, so it was filled with water to just below the perforations which subsequently filled manhole A and B to the corresponding elevation. After one hour of testing, the water surface elevation dropped of 9.5 inches. In order to pass testing, no elevation drop was required. When water was drained from the system, Wilder discovered water leaking from the “wedding ring” in the outflow from Manhole C. Wilder then tested the remaining manholes individually by blocking the outflows and filling them to their lowest perforations. Each passed hyrdrostatic testing with no elevation drop. Wilder then repaired the leaking “wedding ring” in Manhole C via extrusion welding, and the Manhole was retested and passed.

During construction of the stormwater collection and conveyance system components, E&E CQA personnel also ensured that:

- The horizontal layout of the storm drainage system conformed to the design drawings;
- The pipes were placed and the manholes were set to the lines and grades shown on the design drawings by reviewing survey data and conducting periodic inspections with the GPS rover;
- The pipe/manhole trenches, structure bedding, and backfill materials conformed to the design and the backfill material was placed and compacted to specified requirements. Note, the pipe bedding requirements were modified from the design (see Section 2.4; Change Order 2);
- The fusion equipment and materials (for butt-fusion of HDPE smooth wall pipe) were appropriate and functioned properly; and that the butt-fusions complied with the design specifications and the fusion procedures detailed in the approved manuals and plans;
- The corrugated pipe was installed and the joints were constructed in accordance with the manufacturer’s instructions, approved plans, applicable standards, and best construction practices;
- The pipe section air pressure tests were properly executed and the results were properly recorded;
- The perforated collection pipe and filter sock cover was carefully inspected for damage that may cause infiltration of the surrounding drainage sand;
- The cleanout riser pipes were constructed in accordance with the design and approved plans;

- The manhole leakage tests were properly executed and the results were properly documented;
- The concrete outfall structure forms and steel reinforcement were installed in conformance with the design and the concrete was placed as required. See Section 2.4 (letter EE-WC-10) for QC issues associated with the concrete pour. One compressive strength test was performed on a 4” x 8” cylinder by Northwest Testing, Inc. Per Submittal No. 18.5, test results indicate a compressive strength of 5,230 psi (3,000 psi or higher required by specifications);
- The cast-in-place concrete was placed in conformance with the design; and
- The appurtenances (e.g., outfall check valve, manhole ladders, manhole frames/covers, etc.) conformed to the design and were installed as specified.

2.3.2.10 Gas Vents

Four (4) gas vents were installed through the impermeable cap to allow for passive venting of gases that may collect beneath the geomembrane (within the sand leveling layer).

2.3.2.10.1 Materials and Equipment

Schedule 80 PVC pipe and fittings were used to construct the gas vents. Per design, four-inch diameter perforated piping was used for collection (i.e., horizontal section), and four-inch diameter solid wall piping was used for vent risers (i.e., vertical section). The gas vent vaults consist of bottomless HDPE meter boxes manufactured by Carson Industries (model 1730-12). Piping and vaults were supplied by HD Fowler.

2.3.2.10.2 Execution

Gas vent installation occurred from June 29th to July 5th, 2005. Prior to installation of the geomembrane, the horizontal perforated piping sections with center tee (for riser connection) were placed in the leveling sand layer and surveyed with the GPS rover. Following geomembrane installation, holes were cut in the liner at the surveyed tee locations, and the solid wall risers with outlet elbows were then inserted into the tees. Geomembrane boots were then field-fabricated and attached to the riser piping with band clamps (see Section 2.3.2.3). To complete the installation, rodent screens were attached to the vent outlets, HDPE vaults were placed over the outlets, and the bottoms of the vaults were filled with drainage rock.

2.3.2.10.3 Quality Control/Quality Assurance

During installation, Wilder discovered that the configuration shown in the design drawings was not constructible. It was not possible to fit the two 90-degree elbows into the specified vault and have clearance between the drainage rock and the vent outlet. Therefore, the design was slightly modified by the removal of one of the 90-degree elbows. Wilder's QC personnel used the Topcon GPS positioning system for horizontal and vertical alignment confirmation.

To ensure the gas vents were installed as required, E&E CQA personnel performed the following:

- Obtained and reviewed manufacturer's catalog cuts, product data, and certifications, as applicable, to confirm that the gas vent materials met or exceeded the specified requirements in accordance with the design;
- Ensured that Wilder used strict survey control to confirm that the gas vents were installed at the required locations, per design;
- Performed periodic inspections of the on-site fabrication and installation of the gas vents components; and
- Ensured that the liner materials were properly sealed around the gas vent risers.

2.3.3 Soil Cap Construction

The soil cap portion of the upland cap covers 18.9 acres outside of the impermeable cap footprint. It is bound by the property boundaries to the north, south, and east; and transitions into the existing soil cap along the top of bank (see Record Drawings, Appendix K).

Per design, the soil cap was constructed of the following layers (listed in order from bottom to top): reworked and recompacted subgrade; demarcation fabric; and vegetated topsoil layer. Other features of the soil cap include erosion control fabric in the drainage swale areas and a retention pond with spillway. Construction details for each soil cap layer and feature are discussed in the following sections.

2.3.3.1 Subgrade

The purpose of the subgrade preparation activities were to reshape the cap subgrade material to the desired elevations and grades by both cutting and filling operations.

2.3.3.1.1 Materials and Equipment

Subgrade elevation contours were designed to balance cut and fill of existing site soils. Therefore, import of soil materials to achieve specified subgrade elevations was not required. Wilder used typical earth moving equipment to excavate, move, reshape, and compact the existing soils to attain the desired subgrade surface. Equipment utilized included two A35D Volvo dump trucks, two 623B CAT scrapers, a CAT VHP grader, D6R CAT bull dozer, SD1000 Vibratory Roller, CS-563E CAT vibratory roller, 200CC Deere Excavator, 924G CAT IT, and a water truck. The CAT grader was equipped with Topcon grade control equipment that automatically adjusted the height and angle of the blade according to the design subgrade surface (see Section 2.3.1.3).

2.3.3.1.2 Execution

Subgrade construction activities took place from June 8th to approximately June 25th, 2005. The soil cap subgrade was designed to direct surface water, via a swale, to the southwest corner of the site where a retention pond and spillway were constructed (see Section 2.3.3.5). The swale begins in the northwest corner of the site (north of the impermeable cap) and maintains an approximate 0.25% slope around the northern and eastern edge of the impermeable cap until the existing topsoil stockpile. Subgrade preparation beneath the existing stockpile was not required, therefore Wilder performed subgrade activities up to the existing demarcation fabric (previously placed beneath the soil stockpile during sediment cap construction). The remainder of the swale was defined during the vegetated topsoil phase of the soil cap (see Section 2.3.3.3).

To construct the subgrade, existing site soils were cut from some areas and added (i.e., filled) to others. The amount of cut and fill was balanced during the design phase to avoid having a shortage or excess of material. Any excess material that was produced was placed in a designated area immediately southeast of the support facility area. In areas that did not require a significant amount of excavation, Wilder utilized the CAT grader and CAT dozer to roughly cut the material, then utilized the CAT grader to bring the surface to design grade. The scraper would then pick up the cut material and transport it to an area that required fill. At areas requiring substantial excavation to reach subgrade (e.g., the retention pond and spillway), Wilder utilized the 200CC excavator and 924G IT to excavate the material, then used the two Volvo dump trucks to transport the material to fill locations. After fill material was placed, the SD1000 roller was immediately used to compact each lift of fill placed. The CAT grader was then used to obtain the required grade and a final pass was made with the roller for compaction. The water truck was used to add moisture to the soil prior to the material being compacted, as necessary. After the designed grade was obtained, the soil cap subgrade was scarified approximately two inches to allow for bonding between the topsoil and subgrade layers. During grading, objectionable materials such as large wood debris, large rocks, and old geotexile fabric that where brought to the surface were removed to ensure a consistent two-foot cap of clean soil could be placed.

Following construction of the subgrade, Wilder's subcontractor, Northwest (NW) Geotech, performed compaction testing of the completed surface. Design specifications required compaction testing to be performed every 5,000 sf. However, this was revised to every 5000 sf only in areas that had at least four inches of fill. Compaction results were required to be between 75% - 85% maximum dry density. To ensure testing was done at the correct frequency, Wilder developed a grid with cell increments of 5,000 sf, superimposed it on an outline of the site, and downloaded it into the Topcon survey control system. Using the Topcon system, Wilder staked out the grid cell locations for NW Geotech to follow. Results of the compaction testing were referenced to the grid location. NW Geotech performed in-place compaction testing using a nuclear gage per ASTM D2922. Prior to performing compaction testing, NW Geotech collected nine soil samples to develop proctors, per ASTM D698. Since the existing site soils were made up of several different combinations of soil, multiple proctors had to be developed. When performing compaction testing, NW Geotech used the samples collected for the proctors to visually compare to the soil in the area being tested to determine which proctor to use for each test.

Copies of the subgrade compaction test results are included in Appendix D. Most areas tested passed the required 75-85% compaction criteria. If areas did not pass, Wilder tilled the area and then the area was retested by NW Geotech. A few areas of the soil cap subgrade did not pass compaction testing even after reasonable effort by Wilder. In these instances, E&E field engineers made a visual inspection and accepted the results based on adequate effort being applied.

2.3.3.1.3 Quality Control/Quality Assurance

During soil cap subgrade construction activities, Wilder performed quality control utilizing their Topcon grade control system to verify lines and grades, and to verify compaction testing frequency. E&E observed that material was placed in proper lift thickness, moisture was added when needed, and the material was compacted soon after placement. Prior to installation of subsequent layers, E&E performed visual inspections of the surface conditions to ensure all objectionable materials were removed. If areas of concern were noted, Wilder was notified, and the area was re-inspected once materials were removed. E&E also reviewed compaction test results to ensure the frequency and results were compliant with specifications. Because of strict project timelines, Wilder was allowed to continue with construction of subsequent layers (i.e., demarcation layer and topsoil) prior to E&E receiving and approving topographic survey data from their surveying subcontractor, DEA. Wilder was informed that they were proceeding at their own risk if survey information indicated the subgrade topography was not correct. After receiving survey data from DEA, E&E reviewed the grades to verify results were compliant with the design specifications. Copies of the Record Drawings showing as-built subgrade topography are included in Appendix K.

2.3.3.2 Demarcation Fabric Layer

The demarcation fabric delineates the extents of the clean soil cap and serves as a warning marker (i.e., for future land users) that the soils beneath the layer may be contaminated.

2.3.3.2.1 Materials and Equipment

Warning barrier fence was used as the demarcation fabric for the soil cap. The fencing was supplied by NWL and is made of HDPE, is orange in color, and has a UV stabilizer. Panels of the demarcation fabric were fastened together using zip ties.

Wilder utilized the 924G CAT IT to stage the rolls of demarcation fabric and deployed them by hand.

2.3.3.2.2 Execution

Installation of the demarcation layer occurred from June 30th to approximately July 20th, 2005. After the subgrade had been prepared, Wilder used the 924G CAT IT to transport the rolls of demarcation fabric to the installation areas and deployed the rolls by hand. Adjacent rolls were overlapped by at least six inches and fastened together with zip ties approximately every ten feet. Panels laid end-to-end were also overlapped six inches and fastened with zip ties. Rocks or small amounts of topsoil were placed on the corners of the demarcation fabric to prevent wind uplift until the overlying topsoil layer was placed.

2.3.3.2.3 Quality Control/Quality Assurance

Prior to barrier fencing rolls being delivered to the site, product data sheets (i.e, cut sheets) were submitted by NWL through Wilder. E&E reviewed this information to verify the material conformed with design specifications.

During installation, E&E observed that the proper overlap of adjacent panels was maintained and that the panels were fastened at the appropriate intervals. Note, design specifications originally called for adjacent demarcation fabric panels to be overlapped by one foot. However, in lieu of this, E&E approved Wilder's proposal to fasten adjacent panels with zip ties with reduced overlap, as described above. E&E also continuously inspected installed demarcation fabric (which had not yet been covered by topsoil) for damage caused by equipment or environmental factors.

2.3.3.3 Topsoil Layer

Outside the barrier wall, the twenty-four inch thick vegetated topsoil layer serves as a barrier from the underlying contaminated soils and provides water storage capacity to sustain the vegetative cover (thereby reducing infiltration via evaportranspiration). The topsoil layer also helps resist wind and water erosion and enhances the aesthetics of the capped area.

2.3.3.3.1 Materials and Equipment

Topsoil used for construction of the soil cap came from the following three sources:

- The existing stockpile located along the southeastern edge of the property, which was previously imported by MBI from the Reichhold Quarry. This soil is generally classified as a loam (approximately 50% sand; 35% silt; and 15% clay) with cobbles. Chemical analysis was also performed on this soil to verify that the material does not contain any pollutants. A copy of the Technical Memorandum presenting the findings of this analysis is included in Appendix E (note, data validation memos are not included in the Appendix).
- Topsoil imported by barge by RISG from the Avery Pit. This soil is sandier in nature and is classified as a sandy loam (approximately 70% sand; 20% silt; and 10% clay). Texture Classification results are included in Appendix E. No chemical analysis was performed on this soil obtained from Avery, as discussed previously.
- Topsoil trucked in from the Reichhold Quarry by MBI during construction. This soil is similar in texture classification as the existing stockpiled soil (i.e., loam with cobbles).

A map showing the approximate locations where each topsoil type was placed is included as Figure 2-2.

Equipment used to place the topsoil included a Komatsu Loader, two A35 Volvo dump trucks, a D6N and D6R CAT Dozer, two 623B CAT scrapers, and a CAT Grader. RISG used a barge to transport the soil to site and off loaded the soil using a hopper and conveyor set up on the adjacent Metro property.

2.3.3.3.2 Execution

Topsoil had been stockpiled on site from the Reichhold Quarry during previous construction activities. This topsoil was used primarily on the south end of the soil cap and the eastern edge outside of the barrier wall. The remaining portions of the soil cap were constructed with topsoil imported from the Avery Pit by barge and with topsoil trucked in from the Reichhold Quarry (see Figure 2-2).

Wilder began placing topsoil from the existing stockpile outside of the barrier wall on June 29th and began importing topsoil by barge on July 6th, 2005. Construction of the soil cap was completed on September 7th, 2005.

Topsoil that was imported by barge was off loaded using a hopper and conveyor belt system set up on the adjacent Metro property. Once offloaded from the barge, Wilder used a Komatsu loader to place the topsoil into the two A35 dump trucks. The dump trucks transported the topsoil to the site and placed it in the general area where the soil was to be spread. Topsoil imported by truck was directly dumped in the area between the top of bank and the gravel access road. In both cases, after the topsoil was placed, the CAT dozers were used to rough grade the soil, then the CAT grader (equipped with the Topcon grade control system) was utilized for fine grading until final grade was achieved. Topsoil from the existing stockpile was placed using several methods. For the area immediately surrounding the stockpile, the CAT dozers were used to push the soil directly away from the stockpile to the desired location. The CAT grader was then used to bring the topsoil to design grade. If the topsoil needed to be placed away from the stockpile, it was either loaded into the A35D dump trucks using the 200CC excavator, or it was picked up by a CAT scraper and transported to the desired location. Again, after the topsoil was roughly placed, the CAT grader was used to bring it to design grade. Along the eastern edge of the property, a berm (approximately one foot high) was constructed with topsoil to prevent stormwater runoff from the site to the adjacent UPRR tracks. Along the western edge of the property the topsoil layer transitions into the existing soil cap along the top of the bank.

Per contract requirements, the vegetated topsoil layer outside the impermeable cap is approximately twenty-four inches thick. Per design, the topsoil layer was graded (mimicking the underlying subgrade) to direct surface water, via a swale, to the southwest corner of the site where a retention pond and spillway were constructed (see Section 2.3.3.5). The swale begins in the northwest corner of the site (north of the impermeable cap) and maintains an approximate 0.25% slope around the outside of the impermeable to the retention pond.

In order to achieve the required compaction of 75-85% maximum dry density, Wilder did not compact the topsoil after it had been placed. Low compaction was desired to provide favorable soil conditions for vegetation to grow. Once a section of topsoil had been brought to design grade, NW Geotech performed in-place compaction testing using a nuclear gage following ASTM D2922. Per design specifications, compaction testing was performed every 5,000 sf. NW Geotech used the same grid system developed by Wilder that was used for the subgrade, leveling sand layer, and drainage sand layer to determine the location and frequency of testing. Results for the compaction testing were referenced to the grid location. Copies of the compaction test results are included in Appendix D. Areas that did not pass compaction testing were reworked and retested until passing results were achieved. After the topsoil passed compaction testing, it was hydroseeded according to the type of topsoil placed (see Section 2.3.4.3).

2.3.3.3.3 Quality Control/Quality Assurance

Prior to topsoil being delivered to the site, samples were submitted to E&E for approval, and a geotechnical engineer visually inspected the topsoil at its source. Topsoil obtained from the Reichhold Quarry was pre-approved for use at the site. Material samples from the Avery pit, however, did not meet contract requirements for gradation and pH. In order to compensate for the non-conformance to the contract specifications, Wilder was requested to amend the topsoil during hydroseed application (see Section 2.3.4.3).

During placement of the topsoil, Wilder was required to use low ground pressure equipment to protect the underlying demarcation layer and to achieve low compaction. After compaction test results were submitted, E&E reviewed the results to ensure proper frequency and compaction density requirements were obtained. E&E visually inspected the topsoil layer for depressions and to ensure slopes blended well with the edges of the gravel roads and with the transition into the existing cap along the top of bank. Wilder used their Topcon grade control system to place the topsoil to the appropriate thickness, and DEA surveyed the layer at completion. Computer-generated contour maps were then submitted to E&E for review and approval. Areas requiring additional work to attain final design grades were identified by E&E, after which the areas were re-graded by Wilder until a satisfactory topographic survey was achieved.

Copies of the Record Drawings showing as-built topsoil layer final topography are included in Appendix K.

2.3.3.4 Erosion Control Fabric

The purpose of the erosion control fabric is to prevent erosion prior to establishment of vegetation. Fabric was placed along the entire length of the perimeter drainage swale (twenty-five feet to either side of the swale center line) and along areas of the bank that were disturbed during construction (i.e., spillway, outfall, and FWDA).

2.3.3.4.1 Materials and Equipment

Four rolls (four by fifty meters per roll) of existing coir netting (PermeaMat Coir 700-c) were installed atop a portion of the drainage swale. The remainder was constructed with PermeaTex Jute, a biodegradable blanket made from undyed and unbleached woven jute. Individual rolls measured four by two-hundred-twenty-five (225) feet. The jute netting was secured with gauge U-shaped six inch metal staples. The jute rolls and staples were supplied by NWL.

Wilder used the 924G CAT IT to stage the jute netting rolls in various places along the swale. The rolls were deployed/installed by hand.

2.3.3.4.2 Execution

As described above, erosion control fabric rolls were transported to the swale and bank areas by the 924G IT, then were deployed/installed by hand. Adjacent rolls were overlapped by approximately six inches along their lengths and butt seams. Once a roll was deployed, it was secured with U-shaped staples, driven into the ground using sledgehammers at a frequency of approximately three staples per square yard.

2.3.3.4.3 Quality Control/Quality Assurance

Prior to delivery of the erosion control fabric materials, product data sheets (i.e., cut sheets) were submitted by NWL through Wilder. E&E reviewed this information to verify the material conformed with design specifications. During installation, E&E observed that proper overlap of adjacent blankets was maintained and that they were secured (i.e., stapled) at the appropriate frequency.

2.3.3.5 Retention Pond and Spillway

The purpose of the retention pond is to retain surface water runoff from the surrounding capped areas in order to minimize discharges to adjacent properties and the Willamette River. The purpose of the spillway is to provide a protected conveyance channel for stormwater overflow from the pond to the river in the event that the pond exceeds storage capacity during an extreme storm.

2.3.3.5.1 Materials and Equipment

Materials used for construction of the retention pond included existing site soils for the subgrade (see Section 2.3.3.1); demarcation fabric (see Section 2.3.3.2); topsoil from the existing stockpile for the pond sideslopes; and imported sand for the pond bottom. Sand was supplied by RISG, obtained from a quarry located near Avery, Washington.

Materials used for the spillway construction included existing soils for the subgrade (see Section 2.3.3.1); geotexile fabric (see Section 2.3.2.7.1); 12-inch minus rock imported by MBI; and two 20-foot lengths of 8”-diameter corrugated HDPE culverts (used at the gravel road crossing, per Change Order 7).

Wilder constructed the retention pond and spillway using the same equipment used for preparing the overall site subgrade and for placement of the topsoil. Equipment utilized included two A35D Volvo dump trucks, two 623B CAT scrapers, a CAT VHP grader, D6R and D6N CAT bull dozers, SD1000 Vibratory Roller, CS-563E CAT vibratory roller, 200CC Deere Excavator, 924G CAT IT, and Komatsu Loader. The CAT grader was equipped with Topcon grade control equipment that automatically adjusted the height and angle of the blade according to the design subgrade surface (see Section 2.3.1.3).

2.3.3.5.2 Execution

Retention Pond

Shaping of the retention pond occurred during subgrade preparation activities (see Section 2.3.3.1). Significant excavation was required at the retention pond to reach designed subgrade elevations. Wilder utilized the 200CC excavator and 924G IT to excavate the material, then used the two Volvo dump trucks to transport the material to fill locations. The two CAT dozers were used to rough grade the area, then the CAT grader was utilized to bring the surface to design grade. Demarcation fabric was then placed on the bottom and along the sides of the pond in a similar manner as described in Section 2.3.3.2.2. Two feet of imported sand was then placed starting at the lowest elevation of the pond bottom and extended toward the edges until it tied into the surrounding soil cap. The sand was placed similarly as described in Section 2.3.2.2. Two CAT dozers were used to rough grade the sand, then the CAT grader was used to bring the surface to design grade. Along the sides of the retention pond, two feet of topsoil were placed over the demarcation fabric to complete the soil cap as described in Section 2.3.3.3.

Compaction testing was performed for the subgrade and topsoil layers of the retention pond as described in Sections 2.3.3.1 and 2.3.3.3, respectively. Compaction testing of the sand pond bottom was not performed.

Spillway
Construction of the spillway also occurred during subgrade preparation activities. Wilder utilized the CAT dozers to shape the subgrade for the spillway by pushing the cut material up towards the retention pond, then worked the excess material into surrounding subgrade areas. The spillway was constructed differently for the sections above and below the Ordinary High Water (OHW) elevation. The section above the OHW was constructed as part of the two-foot soil cap. After the subgrade was cut to design grade, Wilder installed a layer of eight ounce geotexile, then placed a two foot thick layer of 12”-minus rock to fulfill the two foot cap requirement for this area. Sides of the spillway along this section were matched with the surrounding two-foot topsoil cap. The spillway section below OHW, however, was not constructed as part of the soil cap. For this section, Wilder installed a layer of eight ounce geotexile atop the prepared subgrade, then placed a twelve-inch layer of 12”-minus rock. For both sections, the geotexile was installed by hand, and the two A35D dump trucks and the 200CC excavator were used to place the 12”-minus rock.

To allow for vehicle traffic to cross the spillway, two twenty-foot long eight-inch diameter HDPE culverts were installed in parallel along the flow channel near of top of the spillway. The culverts were then covered with compacted 1.5”-minus crushed rock to match the grade of the adjacent gravel access roads. This work was performed under Change Order 7 (see Section 2.4).

2.3.3.5.3 Quality Control/Quality Assurance

During retention pond and spillway construction, Wilder performed quality control utilizing their Topcon grade control system to verify lines and grades for the subgrade and final grade layers. E&E observed that materials were placed in proper lift thickness and moisture was added, when needed, to achieve required compaction. Prior to installation of subsequent layers over the subgrade (e.g., demarcation fabric or geotextile), E&E performed visual inspections of the surface conditions to ensure all objectionable materials were removed. E&E also reviewed compaction test results to ensure the frequency and results were compliant with specifications for the subgrade and topsoil layers (i.e., sideslopes) of the retention pond. Topographic maps of the subgrade and final grade layers were also submitted by Wilder and reviewed by E&E as described in Sections 2.3.3.1 and 2.3.3.3, respectively.

2.3.4 Other Construction

2.3.4.1 Gravel Access Roads

A network of gravel access roads were constructed within the top layer of the cap to provide vehicle access to various site features (e.g., monitoring wells, manholes).

2.3.4.1.1 Materials and Equipment

The gravel roads are constructed of 1.5-inch-minus crushed rock (ODOT base aggregate) supplied by Morse Brothers. To construct the roads, Wilder used a John Deere 450J bulldozer, a CAT VHP grader equipped with Topcon grade control, a SD 1000 vibratory roller, and a water truck.

2.3.4.1.2 Execution

Wilder began importing the rock on July 17th, 2005, via Van Houten through the access gate at the south end of the property. Use of this route through the University of Portland campus was contingent on Wilder complying with route and speed restrictions agreed upon by Wilder and DEQ. Once the trucks were on-site, they were directed to the location where the rock was to be placed. Wilder used the dozer to roughly place the gravel in the road footprint, per design plans. Following placement of each lift, the gravel was compacted by the roller, and water was added for compaction, as needed. After rough placement of the rock, the CAT grader (equipped with the Topcon grade control system) was then utilized for fine grading until final grade was achieved. Thickness of the gravel roads varied depending on their location within the cap. Within the impermeable cap, the gravel roads are approximately 1-foot thick, installed directly over the geotextile filter layer. Outside of the impermeable cap, access roads are approximately 2-feet thick, installed over the demarcation fabric. Typical road widths are 10 feet. Most of the gravel road construction was completed by August 30th, 2005.

Design specifications required compaction of the gravel roads to 95% maximum dry density (minimum); however, due to the amount of oversized material, NW Geotech could not perform nuclear testing per ASTM D2922. Therefore, verification of compaction was performed by proof rolling. Wilder's water truck was filled then slowly driven on the access roads as NW Geotech and E&E visually inspected the surface for any deflection. If deflection was observed, the area was marked, and Wilder re-compacted the area until no visible deflection occurred.

In addition to the gravel roads required under the original design, two supplemental gravel roads were constructed via change orders. Per Change Order 5 (see Section 2.4), a gravel road was constructed just outside the northwest corner of the property to provide access to monitoring wells MW-18s and EW-9s. This road was constructed by placing geotexile over the subgrade and then placing approximately nine inches of 1.5-inch minus crushed rock. An additional gate was also installed under this change (see Section 2.3.4.2). The second road was constructed under Change Order 9 and is located near the northeast corner of the property to provide direct access to the site from the paved entrance road without passing through the support facility area. This road was constructed by placing approximately 6 inches of gravel directly over the topsoil layer. The road was subsequently enhanced by Wilder with geotextile and additional gravel under a subcontract with E & E.

2.3.4.1.3 Quality Control/Quality Assurance

Prior to rock being delivered to the site, material specifications were submitted for approval by E&E, including sieve analysis. This analysis confirmed that the proposed rock material was in conformance with the design specifications. A copy of the test results is included in Appendix E. In addition, the rock was inspected at the source facility by E&E's geotechnical engineering subcontractor, PacRim Geotechnical. A copy of the geotechnical report is also included in Appendix E.

During delivery of the rock material, E&E performed periodic inspections of the truck traffic through the University of Portland campus to ensure the agreed routes and speed limits were being followed.

During road construction, Wilder utilized the Topcon GPS positioning system and automated grade control to verify lines and grades. During placement of the rock, E&E observed that the material was placed to appropriate depths, moisture was added when needed, and the material was properly compacted. E&E also observed that the placement of gravel did not damage any underlying layers. Once final grading was completed, E&E inspected the roads for low spots or areas where the road did not tie-in smoothly with the adjacent topsoil. If low spots were noted within the road interior, additional gravel was added. If low spots were noted along the road edges, additional topsoil was placed to facilitate drainage.

Following construction completion, DEA surveyed the as-built layout of the roads, as shown on the Record Drawings included in Appendix K.

2.3.4.2 Fencing and Gates

2.3.4.2.1 Materials and Equipment

New fencing was installed along the north, west, and south perimeter of the property and in the support facility area by Willamette Fence Company. Materials used for the perimeter of the site include line posts; 6-foot high 2-inch mesh fencing fabric (fence fabric salvaged from the existing installation was used to the extent possible); post tops that allow for the installation of barb wire; tension bars; fence ties and clips; tension wire, fence bands; and gates. Materials used for the support facility fencing include line posts; 8-foot high 1-inch mesh fencing fabric; post tops that allow for the installation of barb wire; top rails;

tension bars; fence ties; tension wire; fence bands; razor tape; and gates. Willamette Fence Company utilized a bobcat with auger, a small track-hoe, concrete mixer, and hand tools to install the fencing.

2.3.4.2.2 Execution

Perimeter Fencing

Willamette Fence Company began installing fence at the south end of the property on August 15th, 2005, and completed fence installation on September 23rd, 2005. In areas where posts were being installed in the soil cap (outside of the impermeable cap), they used a bobcat with auger attachment to dig the post holes and then hand tools (i.e. post hole digger, shovel) to obtain the required hole depth of approximately 30 inches. Post holes were dug at 10-foot intervals. The post was then placed in the hole and set in concrete. The concrete was originally mixed by hand in a wheelbarrow, but was later mixed using a portable concrete mixer. Along the western edge of the property, the posts are installed down the centerline of the gravel access road. Portions of this section of fence are installed over the impermeable cap. A small track-hoe was used for digging post holes in the compacted gravel access road until the 4-inch minus biotic rock layer was encountered. The hole was then cleared to the drainage sand layer by hand to avoid damage to the underlying liner system. Regardless of location inside or outside the impermeable cap, posts along the gravel road were placed in the hole and then surrounded by a form. The area outside the form was backfilled with gravel and then the form was filled with concrete. Terminal posts and gate posts were installed in a similar manner as line posts except they were installed to a depth of approximately 36 inches outside the impermeable cap and 30 inches inside the impermeable cap. If 30 inches could not be achieved because of the liner system, the diameter of the concrete setting was increased. At each terminal post or gate post, tension bars were installed to counterbalance the tension that would be created by installing the fence fabric.

Once the line posts were installed, post tops were secured to the post, and tension wire was strung along the top and bottom of the posts for the length of the fence section. Fencing fabric was then installed, and fence ties and clips were used to secure the fabric at intervals of approximately 2 feet along the tension wires and approximately 15 inches along the line post. Fencing fabric that had been removed during earlier parts of construction was reused when possible. Three strands of barbwire were installed along the top of the perimeter fence. Willamette Fence Company used hand tools to stretch and secure the barbwire into the fence tops. The barbwire was secured to terminal posts, gate posts, or extended line posts that were installed at curves in the fencing.

Six gates were installed along the perimeter fencing: four along the western edge (along top of bank), one in the northwest corner (per Change Order 5), and one in the southeast corner of the property. Each gate is approximately 14 feet wide and is composed of two swinging gates. They have latches, which permit operation from both sides and are equipped with center gate stops and compatible with padlocks. The tops of the gate panels are also equipped with three strands of barbwire.

Support Facility Fencing

Fencing of the support facility area was transferred from the Support Facility Modifications subcontract to the Upland Cap contract under Change Order 2 (see Section 2.4). Willamette Fence Company excavated the line post, terminal post, and gate post holes using a bobcat with an auger attachment and then used hand tools to clear out the excavation. Posts were then inserted into the excavation and backfilled with concrete that was either mixed by hand in a wheelbarrow or in a portable concrete mixer. Post caps that allow the installation of barbwire and top rails were installed once all posts were set in concrete. Tension wire was installed along the bottom of the line post, and tension bars were installed at terminal and gate post to counterbalance the tension created by the installation of the fence fabric.

Once the support framework was installed, 8-foot 1-inch mesh fencing fabric was installed. The fabric was secured to the line posts at approximately 1-foot intervals and the top rail and tension wire at intervals of approximately 2-feet (using fence ties and clips). Three strands of barbwire were installed along in the post tops, and razor tape was wrapped around the top of the barbwire.

Three gates were installed around the support facility area: one at the entrance and two in the southwest corner (one of which was added under Change Order 8) of the facility to allow for access to the gravel access roads. The gates are double swing gates with latches that allow for operation from both sides, can be locked with a padlock, and have center gate stops. Barbwire and razor tape were also installed along the top of the gates. In the southwest corner of the support facility area, the fencing is grounded by three copper wires attached to rods driven into the ground. One copper wire is attached to each of the three gate posts which grounds the entire support area.

2.3.4.2.3 Quality Control/Quality Assurance

Prior to fencing materials being delivered to the site, cut sheets and data were submitted to E&E for review to confirm design specifications were met. During fence installation, E&E observed that posts were placed along the correct property lines and were properly spaced. E&E inspected installed fence fabric to ensure proper fastening intervals were being maintained and inspected the gates to ensure they functioned and locked properly. If areas of concern were noted (e.g., gaps near bottom of fence, improper gate closure), Willamette Fence Co. was notified and corrected the deficiency. For work in the support facility area, E&E also observed that the fencing was properly grounded.

Within the impermeable cap area, in order to protect the underlying liner system, E&E and Willamette Fence Company discussed to what depth excavation could occur by track-hoe and at what point they would be required to dig post holes by hand. It was decided that once the track-hoe hit the 6-inch layer of biotic rock, hand tools would be used to excavate to the sand drainage layer and then the post would be set. During excavation of two post holes, the geomembrane liner was penetrated and had to be repaired by NWL because excavation by the track-hoe was not halted when the biotic rock was encountered. Following this incident, E&E was present at all times during post excavation over the geomembrane to ensure no further damage occurred and to ensure hand tools were used when needed.

2.3.4.3 Seeding

2.3.4.3.1 Materials and Equipment

Seed

Based on a revegetation plan developed by the City of Portland Bureau of Environmental Services under an Intergovernmental Agreement with DEQ, the upland cap was divided into five different vegetation zones, each with their own type of seed mix. These zones include: Impermeable Cap (Open Grassland), Pond Side Slopes, Pond Bottom, Swale Areas, and Soil Cap. See Figure 2-3 for the locations of each zone and Table 2-1 for a list of the seed mix compositions.

There were also two areas outside the McCormick and Baxter property line that were hydroseeded with an ODOT native seed mix. These areas include a stretch of Van Houten at the south end of the property and the Metro property used for barge offloading area.

Hydroseeding was performed by NW Hydromulchers, and the seed mixes were provided by SunMark seeds (sub to NW Hydromulchers).

Amendments

Two different combinations of amendments were used in the hydroseed mix depending on the type of topsoil where the seed was to be applied. As described in Sections 2.3.2.8 and 2.3.3.3, topsoil was obtained either from the Reichhold Quarry (from the existing stockpile or trucked in by Morse Brothers) or the Avery Pit (barged). Upland cap areas with topsoil from Avery or a combination of Avery and Reichhold soil received supplements consisting of Quattro Environmental Nutrient Blend #5646, Fertile Fibers, Kiwi Power, humic shale, liquid humus, and tackifier (per Change Order 3; see Section 2.4). Areas capped with Reichhold topsoil cap were amended with Quattro Environmental Nutrient Blend #5647, mat fiber, and tackifier (per Change Order 8; see Section 2.4).

Compost

Prior to hydroseeding, compost was placed along river bank areas that were disturbed during construction. These areas included along the pond spillway, along the outfall, and near the northwest corner. Compost was supplied and placed by Rexius (subcontractor to NW Hydromulchers).

Equipment

NW Hydromulchers utilized two hydroseeding trucks. One truck consisted of a large flat bed with a 1,750-gallon hopper. The hopper was equipped with a continuous mixer (to ensure the mixture was homogenous) and a pump. A work platform equipped with a high pressure cannon, hoses, and multiple nozzle fittings for spreading the seed mix was located near the top of the hopper. The second truck towed a trailer that was equipped with a 1,200-gallon hopper. This smaller hopper was also equipped with a high-pressure cannon, continuous mixer, pump, hoses, and multiple nozzle fittings. NW Hydromulchers utilized a 586G CAT Forklift to add the amendments into the hoppers. Rexius used a truck equipped with a blower and hose to apply the compost.

2.3.4.3.2 Execution

Hydroseeding began on September 6, 2005, and most areas were completed by September 20, 2005. Seeding occurred in three phases: the initial gross seeding; a second seeding to cover areas not previously ready for seeding; and a final seeding to touch up any areas disturbed due to continued construction activities. Each phase was performed as described below.

Prior to NW Hydromulchers arrival, site maps were created by E&E showing the five different seed zones and four different areas of topsoil (see Figures 2-2 and 2-3). The appropriate seed mix and amendments for each area were determined using these maps. The truck equipped with the 1,750-gallon hopper was used to hydroseed areas with topsoil from Avery or combination of Avery and Reichhold. For these areas, each seed mix batch covered approximately 1/2 acre. Areas with topsoil from the existing stockpile or trucked from Reichhold were covered in 1/3-acre batches. Batches that were mixed with the smaller 1,200-gallon hopper covered approximately 1/4 acre. To mix a batch, NW Hydromulchers used the fire hydrant (located near the shop building) to add water into the hopper while adding the appropriate seed and amendments. Once the mix was prepared, the hydroseed crew drove to the desired location and applied the mix using the high-pressure cannon. At certain locations not easily accessible by truck or beyond reach of the cannon, the hydroseed was applied from the ground using a long hose attached to the hopper. This was performed along the Van Houten restoration area and near the lower portion of the spillway that had been composted.

2.3.4.3.3 Quality Control/Quality Assurance

Once seed certificates for each variety of seed were delivered, E&E used the percent of Pure Live Seed (PLS) to calculate the equivalent lbs/acre needed. Prior to seeding, the section to be seeded was calculated by direct measurement (or from AutoCAD), and the number of batches to cover the area was determined. Dividing the property into smaller sections allowed E&E to better ensure the proper rate of application. After a batch was applied, E&E would measure the approximate area covered to determine if the proper application rate was being followed.

E&E also observed the mixing of each batch to ensure the correct variety of seed and amendments were being used and that they were being mixed in the proper proportions. In addition, E&E performed routine inspections of areas seeded to identify locations requiring additional seed.

2.3.4.4 Monitoring Wells

Prior to construction of the upland cap, twenty-eight (28) existing monitoring wells were modified to compensate for changing surface elevations. In addition, four new monitoring wells (MW-59s, MW-60d, MW-61s, and MW-62i), and three replacement wells (MW-1r, MW-10r, and MW-35r) were installed. Work was preformed by Cascade Drilling, Inc. (CDI), from June 14th through the 28th, 2005.

All wells modified contained steel protective outer casings; however, the inner casings varied between stainless steel (SS) or PVC. Wells with stainless steel inner casings were extended by welding a new section of stainless steel casing on top of the existing inner casing. Wells constructed from PVC were extended using a coupler to connect the new section of PVC casing. The length of the extension depended on the projected final surface elevation. Some wells were extended by as much as 5.5-feet (e.g., MW-23), while others (e.g., EW-10s) were extended only 1 foot. All wells were modified to stand 2 to 3 feet above final surface elevation. Due to changes in final grade elevation in the FWDA all monitoring wells in this area were raised an additional time in order to achieve the required 2-3 feet above final surface grade. Monitoring wells MW-17s, EW-15s, and EW-8s were not originally designated to be raised, however due to the tie-in of the cap with the top of bank, these three wells were also raised under Change Order 5 (see Section 2.4). After the cap was complete, concrete pads were installed around all monitoring wells, and bollards were installed around the wells located outside of the impermeable cap.

The Record Drawings included in Appendix K show the locations of the new and replacement wells. Copies of the borelogs are on file at the DEQ and E&E offices in Portland (submittal number 033)

2.3.4.5 Waste Disposal

Wilder disposed of 39.71 tons of waste during the course of construction. Two waste streams were generated: non-hazardous and special waste. No hazardous waste was disposed of off site. Waste was contained onsite in large dumpsters provided by Waste Management. Once full, Waste Management removed the dumpster and disposed of its contents at Hillsboro Landfill and then replaced it with an empty one. Materials that were disposed of off site include non-vegetative debris and refuse resulting from clearing/grubbing operations (note, old railroad ties encountered were disposed as special waste), monitoring well debris, and materials and packaging resulting from construction activities (e.g., protective covers for geosynthetics). Weight receipts from the off site disposal facility were provided to E&E and DEQ with Wilder's invoices.

Water generated during decontamination of vehicles and equipment was allowed to infiltrate into site soils by discharging onto the existing ground surface prior to placement of the cap. Monitoring well drill cuttings (from new well installation) were temporarily drummed and then disposed of by empting them within the barrier wall prior to placement of the new cap.

2.3.4.6 Asphalt Pad

2.3.4.6.1 Materials and Equipment

Pavement of the Support Facility Area was transferred from the Support Facility Modifications subcontract to the Upland Cap contract (under Change Order 6; see Section 2.4). Wilder subcontracted Eagle Elsner for pavement of the area. Wilder used the CAT VHP grader, SD 1000 roller, CAT 450J Dozer, and Komatsu Loader for preparing the subbase for paving. Eagle Elsner used a CAT 140G Grader, AP-1055B CAT paving machine with a Carlson screed, Ingersoll-Rand DA-48 roller, and a plate compactor for preparing the subbase and paving activities. Materials used include ¾-inch minus rock, geotexile fabric, and hot mix asphalt concrete (HMAC).

2.3.4.6.2 Execution

Prior to paving, Wilder prepared for pavement activities by scrapping off approximately 4-inches of the top layer of material (subbase) at the support facility area utilizing the VHP grader and dozer. The material was removed so that 4-inches of new ¾-inch minus rock (base) could be placed beneath the HMAC. A layer of geotexile material was installed between the new base and subbase material. The required base thickness was achieved using a laser grade control system. Following placement of the rock, the base was compacted with a roller.

Paving occurred on September 10th, 2005. Paving activities were initiated at areas that required the asphalt to be placed by hand (i.e. behind shop building, beside containment area). Hand rakes, wheel barrows, and a plate compactor were used for transportation and placement in these areas. Where machine placement occurred, the CAT Paver laid the 4" layer of asphalt. After laying the asphalt, the surface was rolled using the Ingersoll-Rand roller. Approximately fifteen passes were made with the paver to cover the support facility area and the site access road.

2.3.4.6.3 Quality Control/Quality Assurance

E&E oversight personnel were present during paving activities to ensure that the proper areas were covered and the proper slopes were maintained to facilitate drainage. E&E also observed that proper thickness and compaction were achieved.

2.3.4.7 Organoclay Patches

2.3.4.7.1 Materials and Equipment

Wilder installed twenty-three (23) organoclay mats (each measuring 100 feet by 15 feet) supplied by CETCO atop a portion of the river sediment cap in an area located southwest of the TFA. This work was performed under Change Order 9 (see Section 2.4). Wilder used sand, 4-inch minus rock, and 10-inch minus rock for layers installed below and above the mats. Equipment utilized during installation of the mats includes a CAT 120C Excavator, CAT D6N Dozer, CAT 950 Loader, two Yanmar 90 All-Tracks, and a Gradall Forklift.

2.3.4.7.2 Execution

Installation of the organoclay patches occurred from October 18th to October 31st, 2005.

In order to provide site access for equipment and delivery trucks, a new gravel access road was installed in the northeast corner of the property (see Section 2.3.4.1). Wilder created a staging area at the top of bank just above where the organoclay mats were to be installed. This area was used to stage equipment and stockpile sand, 4-inch minus rock, and 10-minus rock. A layer of sand was placed over the exposed ACB to prevent damage by equipment traffic.

Prior to installation of the organoclay mats, a protective layer of sand was placed over the existing ACB armoring and TRM. Sand was delivered to the top of bank by truck and then loaded into the All-Tracks using the loader. The All-Tracks transported the sand to the water and unloaded the sand in the general area where it was to be spread. Wilder then used the dozer to spread the sand to a thickness of approximately 6-inches over an area of approximately 300 feet by 60 feet. Wilder also utilized the excavator to reposition one of the boulder cluster that was located within the footprint of the organoclay mat.

After the sand was placed, the organoclay mats were installed. Wilder utilized the excavator with a spreader bar for deploying the mats. Mats were placed on the spreader bar and attached to the excavator at the top of bank and then transported to the edge of the water. The end of the mat was held by three to four people then the excavator backed up to unroll the mat. Once the mat had been unrolled a distance of 60 feet, it was cut, and the remaining 40 feet was placed adjacent to the 60-foot section and overlapped. This process was repeated with various lengths to cover an area extending approximately 60 feet into the river and 300 feet along the bank. A smaller secondary patch was also placed over an observed seep area. This patch measures approximately 15 feet by 30 feet and is located approximately 20 feet south of the large organoclay placement. Note, Record Drawings showing locations of the patch areas are provided in the *Construction Summary Report*, *Sediment Cap Completion (August 2005 through October 2005)* prepared by E&E.

As organoclay mats were placed, Wilder covered them with a protective layer of sand. They utilized the All-Tracks for transporting the sand from the top of the bank to the river, and the dozer to spread the sand to a thickness of approximately 12-inches. After the sand layer was installed, a 4-inch layer of 4-inch minus rock was installed atop the sand also utilizing the All-Tracks for transportation and dozer for spreading. The final layer consisted of 10-inch minus rock. Wilder utilized the All-Tracks for material transportation from the top of bank to the water then used the excavator to place the rock to an approximate 12-inch thick layer.

Once installation of the organoclay mats was complete, Wilder began site restoration. The access road created from equipment going down the bank was left in place to serve as an access road should it be required again in the future. Wilder restored the top of bank to its original condition and hydroseeded disturbed areas.

2.3.4.7.3 Quality Control/Quality Assurance

Materials used during the installation of the organoclay mats were approved during previous construction activities. During installation, E&E inspected the various layers for proper thickness and uniformity. E&E also observed and participated in the deployment of the organoclay mats to ensure proper placement and overlap were obtained. After installation was complete, E&E ensured that Wilder performed all necessary site restorations.

2.3.4.8 Riprap Placement along Edge of ACB

Under Change Order 4 (see Section 2.4, below), Wilder placed 2-foot diameter riprap at four areas along the shoreward edge of the ACB to provide additional armoring over the sediment cap where erosion of the ACB edge treatment was observed. In Willamette Cove, the total length of two placement areas was approximately 80 feet. Immediately upstream of the railroad bridge the length was approximately 75 feet; and near the outfall, the riprap placement was approximately 30 feet. At each location, the riprap was placed to approximately 3 feet high and 4 feet wide.

The riprap was delivered to the site by truck and unloaded. For the Willamette cove areas, Wilder used the loader to transport the riprap to the desired locations (note, prior to placing the riprap in Willamette Cove, Wilder constructed a sand road along the cove’s shoreline to protect exposed ACB from heavy equipment). For the other areas, Wilder used the excavator to load the riprap into the Volvo

A35 dump trucks for transport to the required locations. After the material was unloaded at each area, the 200CC excavator was then used to place the riprap at its final locations under the supervision of E&E and DEQ. Wilder also stockpiled approximately 100 tons of riprap onsite for future use.

2.4 Change Orders and Project Deviations

Project activities were modified in response to unexpected conditions, requests for additional work, and adjustments to the site work directed by DEQ and E&E. A total of ten (10) change orders were issued during the project. The following list contains brief descriptions of each change order:

- Change Order 1:
    - Permitted premobilization.
    - Changed various earthwork (Section 02200) specifications.
- Change Order 2:
    - Added the following extra work to the contract: support area grading; and fencing around the support area (moved from Support Area Modifications subcontract).
    - Provided additional monitoring well installation/modification information.
    - Removed requirement to place import sand for pipe bedding.
- Change Order 3:
    - Approved use of topsoil from the Avery Quarry provided it was amended.
    - Allowed utilization of 1.5”-minus rock for construction of temporary access road.
- Change Order 4:
    - Added the following extra work to the contract: supply and place 2 ft. rip-rap along the ACB edge; stockpile 100 tons of rip-rap in the FWDA (for future use).
- Change Order 5:
    - Added the following extra work to the contract: new gate and gravel road in FWDA to access wells outside fence; extend monitoring wells EW-8s, MW-17s, and EW-15s; supply 400 tons sand, 100 tons 4”-minus rock, and 100 tons 12”-minus rock for future use; and assist with sediment cap patch.
- Change Order 6:
    - Added the following extra work to the contract: pave support area (moved from Support Area Modifications subcontract); and extend support area fencing so entire asphalted area is enclosed.
- Change Order 7:
    - Added the following extra work to the contract: place additional jute matting along exposed river bank slopes; install culverts at spillway; and flush mount MW-59s.
- Change Order 8:

  - Added the following extra work to the contract: add mineral supplements to the cap areas covered with the soils obtained from the Reichhold Quarry; remove and replace fence posts to a straight alignment around MW-59s; restore VanHouten; apply compost on the exposed river bank slopes; place extra rock for gravel road turning radii; install sign posts; provide extra bag of seed (and remove sterile wheatgrass from seed mixes); install additional gate at support pad; and apply extra seed along top of bank.
  - Provided quantity adjustments for unit bases pay items.
  - Increased number of on-site working days from 74 to 92.
  - Extended field work completion date from September 16, 2005, to September 30, 2005.
- Change Order 9:
  - Added the following extra work to the contract: supply and install materials for sediment cap seed repair; and install new gate by the N. Edgewater entrance to the site.
  - Increased number of on-site working days from 92 to 106.
  - Extended field work completion date from September 30, 2005, to November 4, 2005.
- Change Order 10:
  - Extended contract completion date from December 31, 2005, to January 30, 2005.

Copies of each change order are included in Appendix F. Costs, if any, associated with each change order are presented in Section 3.

In addition to change orders, other minor changes in sequencing, site layout, or construction procedures that weren't in conflict with the intent of the project plans and specifications were performed. These changes were authorized through work directives issued by E & E oversight personnel. These directives along with clarifications and other significant communications were issued and documented by E & E through formal correspondence letters (numbered "EE-WC-#"). Copies of these letters are included in Appendix F.

2.5 Health and Safety

E & E site personnel in conjunction with the construction contractor's personnel were responsible for providing guidance and inspection to ensure proper health and safety procedures were followed at the site during construction activities. All contractors and consultants performing work on the site developed and implemented their own site safety plans in accordance with the provisions of the Occupational Safety and Health Administration (OSHA) Standards (29 CFR 1910) and General Construction Standards (29 CFR 1926), including OSHA Hazardous Waste Operations and Emergency Response, Interim Final Rule (29 CFR 1910.120). Compliance with all other applicable federal, state, and local laws and regulations was also required.

A formal safety meeting was held at the beginning of the project to review safety procedures with all site personnel and inform workers of potential hazards. Daily safety meetings to discuss physical and chemical hazards associated with the day's activities were conducted each morning before work began. Site safety briefings were also conducted for all new personnel reporting to the site.

Protective clothing, such as a hard hat, steel-toed boots, and safety vests, was required for entry into the site's work zones. Safety glasses were required while working around excavations into contaminated soil, and as needed. The primary physical hazards at the site included heavy equipment operation; noise; slips; trips; and falls. At the start of the project and during excavation into contaminated soils for conveyance pipe installation, Wilder utilized an on-site Health and Safety Officer. During this time, a selection of workers wore monitoring and sampling devices. Samples were analyzed to determine if additional PPE was required. The results of the health and safety monitoring did not warrant additional PPE during construction, nor did monitoring devices indicate attainment of exposure levels. During dry conditions, Wilder controlled dust by water application with a water truck to help prevent on-site personnel and the public from being exposed to airborne contamination.

2.6 Community and Tribal Relations

The McCormick & Baxter site has been identified as a potentially archaeological sensitive area. The McCormick & Baxter site is also situated in close proximity to a residential neighborhood and receives substantial public and media attention because of its listing on the National Priorities List (NPL). The following subsections describe activities employed by DEQ to maintain a proactive approach to community relations prior to and during construction of the upland cap.

2.6.1 Public Outreach and Town Meetings

Prior to and during construction, DEQ representatives attended public meetings to allow DEQ and the community to exchange information/concerns and answer questions. This enabled construction to proceed with support of the local community and avoid conflicts that could potentially slow or stop construction.

Prior to and during upland cap construction, DEQ representative Kevin Parrett attended meetings with and gave presentations to:

- St. John's Neighborhood Association – May 9, 2005
- Portland Harbor Community Advisory Group – May 11, 2005
- Overlook Neighborhood Association – May 17, 2005
- University Park Neighborhood Association – May 23, 2005
- Portland Harbor Community Advisory Group – July 29, 2005
- University Park Neighborhood Association – August 15, 2005
- North Portland residents – October 19, 2005

- Portland Harbor Community Advisory Group and North Portland residents – November 13, 2005

2.6.2 Press Release

Prior to construction of the upland cap, DEQ published a press release on May 23, 2005. This press release informed the public about what was going to occur, who was going to do it, and how it was to be funded. A copy of the release is included in Appendix G.

2.6.3 Tribal Governments and Archaeological Survey

As presented in the *Archaeological Monitoring Protocol* (EPA/DEQ 2003), the following six tribal governments were identified as having an interest in the cultural resource work at the site:

- Confederated Tribes of the Grand Ronde Community of Oregon;
- Confederated Tribes of Siletz Indians of Oregon;
- Confederated Tribes of the Warm Springs Reservation of Oregon;
- Confederated Tribes of the Umatilla Indian Reservation;
- Confederated Tribes and Bands of the Yakama Indian Nation; and
- The Nez Perce Tribe.

As discussed in Section 1.2, the Tribes were involved with the decision making processes throughout the RD phase. The Tribes were also invited by DEQ to perform monitoring during RA construction activities to survey for potential historic properties, human remains, funerary objects, and other cultural items. Unlike the barrier wall construction, though, a written monitoring plan was not developed. Rather, an informal approach based on discussions between DEQ and the Tribes was followed. During construction, however, the Tribes did not elect to perform any monitoring activities.

Following construction completion of the upland cap, professional archaeologists from Archaeological Investigations Northwest (AINW) performed an archaeological survey of the site to document and recover any artifacts observed. No evidence of any artifacts or other archaeological deposits was observed during the survey. A copy of AINW's archaeological survey report is included in Appenidx G. In addition, during construction of the sediment cap in 2004, AINW also performed monitoring of the topsoil imported from the Reichhold Quarry used for the riverbank cap and stockpiled for the upland soil cap. No evidence of any artifacts or other archaeological deposits was observed [see the *Sediment Cap Construction Summary Report* (E&E 2006) for additional details].

2.7 Documentation

2.7.1 Oversight Documentation

E & E oversight engineers completed construction reports on a daily basis. Copies of the *Daily Field Reports* are included as Appendix H. Items recorded on each report included weather conditions; on-site personnel; site visitors; major equipment used; materials delivered to the site; non-conformances noted; safety concerns noted; environmental monitoring; work completed; and miscellaneous notes and issues. E & E engineers also maintained field activity logbooks which included detailed documentation of materials or equipment delivered; records of inspections performed; work progress; planned activities; a photo-documentation log; reports of minor field changes; and field problems. A digital camera was used for photo-documentation. Select photos are included in Appendix I.

2.7.2 Employee and Visitor Log

An Employee and Visitor Log was maintained by Wilder for the duration of the project. All personnel working at or visiting the site were required to sign the log and provide information including date, name, affiliation, purpose for visit, time in, and time out. E&E maintained a separate log for their employees and Operations and Maintenance contractor.

2.7.3 Weekly Progress Meetings

Each week, Wilder held a weekly progress meeting to discuss project issues including, but not limited to, schedule, installation progress, submittals, problems encountered, and health and safety. Attendees included DEQ’s project manager and contract officer; E & E’s project manager, project engineer, and lead oversight engineer; and Wilder’s project manager and QCI. The meetings were conducted by Wilder’s project manager. After each meeting, E & E prepared work directives or change orders, as needed, to address issues discussed in the progress meeting. The minutes of the weekly meetings are included in Appendix J.

2.7.4 Record Drawings

Survey data was collected by DEA for each layer of the upland cap prior to subsequent layers being placed. DEA also surveyed features such as manhole, gas vent, and pipe clean out locations; outfall and spillway locations; fencing; modified and new monitoring wells; and gravel access roads. Following surveying, DEA developed record drawings showing the as-built locations of the site features. A copy of the Record Drawings prepared by DEA is included as Appendix K.

A copy of the geomembrane Record Drawing from NWL showing the as-built layout and locations of destructive tests, bead repairs, patch repairs, and boots is also included in Appendix K.

An aerial photograph showing the final site features is included as Figure 2-4.

2.8 Chronology of Major Events

Following is a list of major events that occurred during the RA:

- **5/10/05 –** Contract awarded and Notice to Proceed issued to Wilder.
- **6/01/05 –** Preconstruction Kickoff Meeting held at BES Labs. Representatives from DEQ, E&E, Wilder, Cascade Drilling, and DEA present.
- **6/06/05 –** Wilder began mobilization and delivery of materials and equipment to site. E&E oversight personnel also mobilized to the site.
- **06/06/05 –** Wilder began clearing/grubbing and working on subgrade.
- **06/07/05 –** Wilder started fusion welding smooth-walled HDPE conveyance piping.
- **06/08/05 –** Wilder began excavation for manholes and conveyance piping.
- **06/13/05 –** Wilder started excavation of trench from Manhole D to outfall.
- **06/14/05 –** Cascade Drilling began modifying monitoring wells.
- **06/15/05 –** Work initiated installation of outfall structure. Wilder completed majority of work for the conveyance piping installation, including backfilling.
- **06/21/05 –** Cascade Drilling completed monitoring well modifications and began installing new wells.
- **06/21/05 –** Wilder started preparing barge off-loading area on the adjacent Metro property.
- **06/21/05 –** Wilder began installing demarcation fabric for access road through the northeast corner of the site.
- **06/23/05 –** Ross Island Sand & Gravel (RISG) began assembling hopper and conveyor at the barge off-loading area.
- **06/27/05 –** Wilder started work on the anchor trench. The majority of the subgrade work was complete.
- **06/27/05 –** RISG and Wilder began importing and placing the sand leveling layer.

- **06/30/05 –** Wilder began installing demarcation fabric over the subgrade and began placing topsoil from the existing stockpile (outside of barrier wall). Wilder completed placement of sand leveling layer (within barrier wall).
- **06/30/05 –** Cascade drilling completed initial well installations.
- **07/06/05 –** RISG began importing topsoil by barge, and Wilder began placement.
- **07/06/05 –** Northwest Linings (NWL) began installation of the geomembrane.
- **07/08/05 –** Wilder started excavation of the retention pond spillway.
- **07/11/05 –** Wilder began placing rock at the retention pond spillway.
- **07/12/05 –** NWL began installing geocomposite over the geomembrane.
- **07/14/05 –** Wilder started installation of perforated collection piping.
- **07/15/05 –** Wilder began placing the drainage sand layer.
- **07/18/05 –** Wilder began placing 1.5” minus rock for permanent gravel access roads.
- **07/20/05 –** Wilder completed placement of demarcation fabric.
- **07/28/05 –** NWL completed installation of geomembrane.
- **07/28/05 –** Ferguson welded ‘wedding rings’ into manholes.
- **07/29/05 –** NWL completed installation of geocomposite.
- **07/29/05 –** Wilder began importing and placing biotic rock.
- **07/29/05 –** Tour for the Citizens Action Group conducted.
- **08/03/05 –** NAPL releases (bubbles) noticed along riverbank of site. Per directive of DEQ project manager, Wilder placed one A35 truck load of sand over release location.
- **08/05/05 –** Wilder began installing geotexile layer over biotic rock.

- **08/09/05 –** Organoclay mats installed over observed NAPL release area noted on 08/03/05.
- **08/11/05 –** Wilder completed placement of sand drainage layer.
- **08/11/05 –** Wilder began working on Change Order #4, placing 2' rip-rap in Willamette Cove.
- **08/15/05 –** Willamette Fence began installing new fencing.
- **08/16/05 –** Wilder began placing topsoil over the impermeable cap.
- **08/17/05 –** Wilder initiated installation of jute netting along the swale area.
- **08/22/05 –** Cascade Drilling returned to site to make additional well modifications.
- **08/23/05 –** Wilder completed installing geotexile materials over biotic rock.
- **08/25/05 –** Willamette Fence penetrated the liner system while installing fence post. NWL was contacted to repair the area.
- **08/27/05 –** NWL repaired the damage liner caused by Willamette Fence on 8/25/05.
- **08/29/05 –** Wilder began relocating E&E/DEQ trailers so the support area could be paved and began demobilizing their trailer.
- **08/31/05 –** Wilder completed rough placement of topsoil in the impermeable cap area.
- **08/31/05 –** RISG dismantled their hopper and conveyor system at the barge off-loading area.
- **09/01/05 –** Wilder completed installation of jute netting along the swale.
- **09/01/05 –** AINW performed archeological walk of the Upland cap. No artifacts were found.
- **09/02/05 –** Wilder performed restoration of the barge off-loading area.
- **09/06/05 –** NW Hydromulchers began hydroseeding.

- **09/09/05 –** Compost was placed along disturbed areas of the bank.
- **09/09/05 –** Cascade drilling completed well modification and bollard and concrete pad installation.
- **09/10/05 –** Eagle Elsner paved support facility area.
- **09/20/05 –** Majority of hydroseeding completed.
- **09/23/05 –** Willamette Fence completed installation of the site perimeter fence and support facility area fence.
- **09/26/05 –** Joint State-EPA inspection performed.
- **10/18/05 –** Wilder began working on Change Order #9 (sediment cap repairs).
- **10/31/05 –** NW Hydromulchers hydroseeded area disturbed during the implementation of Change Order #9.

2.9 Unresolved Issues

The only unresolved issue at the completion of the cap construction contract involved the area immediately adjacent to the northwestern edge of the support area where leftover ACB sheets (remnants from the 2004 sediment cap construction) were being stored. It was the original intent to remove the ACB and then use topsoil to complete the cap in this area (approximately 80 feet by 100 feet). However, the ACB was not removed in time, therefore Wilder was directed (under EE-WC-19) to stockpile approximately 450 cubic yards of topsoil adjacent to this area to be later used to complete the cap once the ACB was removed.

Subsequent to the cap construction contract, it became apparent that disposal of the ACB was problematic. Therefore, under a separate contract, the ACB was moved nearby to the top of the existing cap, and the stockpile of topsoil was pushed into the ACB area. However, before this could be completed, the ground became excessively wet, and the topsoil could not be effectively placed. Additional topsoil may also be needed to complete this area. This issue will be resolved in the spring of 2006, when the soil moisture is suitable for placement.

<u>TABLE 2-1</u>

List of Herbaceous Species Seed Mixes Applied During Upland Cap Construction

McCormick & Baxter Superfund Site
Portland, Oregon

<u>Herbaceous Species (see Figure 2-2 for area boundaries):</u>

1. Impermeable Cap (Open Grassland) - 14.3 acres

Herbaceous species	**Common Name**	**Lbs./acre**
Festuca rubra var. comutata	Chewings Fescue	6
Hordeum brachyantherum	Meadow barley	5
Deschampsia elongata	Slender hairgrass	6
Bromus carinatus (Silverton low-growing eco-type)	California brome	4
Phacelia nemoralis	Shade phacelia	0.5
Collomia grandiflora	Large-leave collomia	1
Gilia capitata	Globe gilia	2
Lupinus polyphullus	Large-leaved Lupine	2
Solidago canadensis	Canada goldenrod	0.5

2. Soil Cap - 16 acres (note, meadow checker-mallow was removed from design mix due to availability)

Herbaceous species	**Common Name**	**Lbs./acre**
Festuca rubra var. comutata	Chewings Fescue	5
Hordeum brachyantherum	Meadow barley	6
Deschampsia elongata	Slender hairgrass	4
Bromus carinatus (low-growing Silverton eco-type)	California brome	6
Lotus purshiana	Spanish Clover	1
Clarkia amoena	Clarkia	2
Gilia capitata	Globe gilia	2
Lupinus polyphullus	Large-leaved Lupine	1
Solidago canadensis	Canada goldenrod	0.5

3. Swale Areas (Wet Meadow) - 2.8 acres (note, sterile wheatgrass was removed from design mix)

Herbaceous species (seed)	**Common Name**	**Lbs./acre**
Festuca rubra var. comutata	Chewings Fescue	10
Glyceria occidentalis	Western mannagrass	2
Deschampsia cespitosa	Tufted hairgrass	2
Deschampsia elongata	Slender hairgrass	5
Hordeum brachyantherum	Meadow barley	4
Agrostis exerata	Spike bentgrass	4
Prunella vulgaris ssp. lanceolata	Self-heal	3
Lotus purshiana	Spanish clover	1
Grindelia integrifolia	Willamette Valley gumweed	1

4. Pond Side Slopes (Wet Meadow) - 0.5 acres (note, sterile wheatgrass was removed from design mix)

Herbaceous species (seed)	**Common Name**	**Lbs./acre**
Beckmania syzigachne	Western sloughgrass	8
Glyceria occidentalis	Western mannagrass	4
Deschampsia cespitosa	Tufted hairgrass	4
Deschampsia elongata	Slender hairgrass	4
Hordeum brachyantherum	Meadow barley	3
Agrostis exerata	Spike bentgrass	1
Alopecuris geniculatus	Meadow foxtail	1

5. Pond Bottom (Wet Meadow) - 0.3 acres

Herbaceous species (seed)	**Common Name**	**Lbs./acre**
Deschampsia elongata	Slender hairgrass	20

6. Area Between Gravel Access Road and Top of Riverbank - 1.2 acres (note, meadow checker-mallow was removed from design mix due to availability)

Herbaceous species	**Common Name**	**Lbs./acre**
Festuca rubra var. comutata	Chewings Fescue	5
Hordeum brachyantherum	Meadow barley	6
Deschampsia elongata	Slender hairgrass	4
Bromus carinatus (low-growing Silverton eco-type)	California brome	6

Lotus purshiana	Spanish Clover	1
Clarkia amoena	Clarkia	2
Gilia capitata	Globe gilia	2
Lupinus polyphullus	Large-leaved Lupine	1
Solidago canadensis	Canada goldenrod	0.5

7. Offsite Areas including VanHouten and Willamette Cove/Metro Property (seeded with a Native Streambank Mix from Sunmark Seeds)

Herbaceous species	**Common Name**	**Lbs./acre**
Elymus glaucua	Blue Wildrye	18
Festuca rubra	Native Red Fesue	9
Bromus carinatus (low-growing Silverton eco-type)	California brome	3

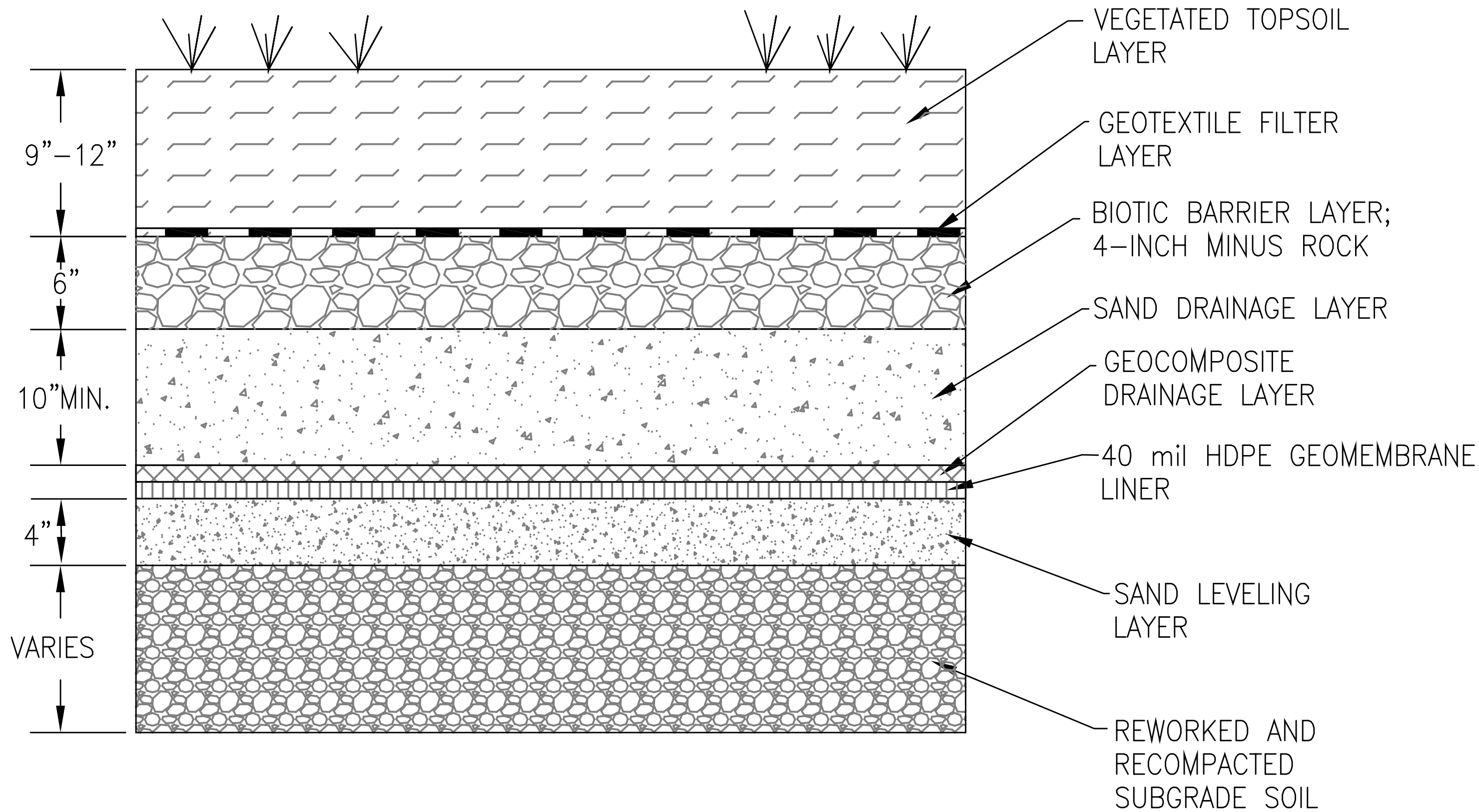
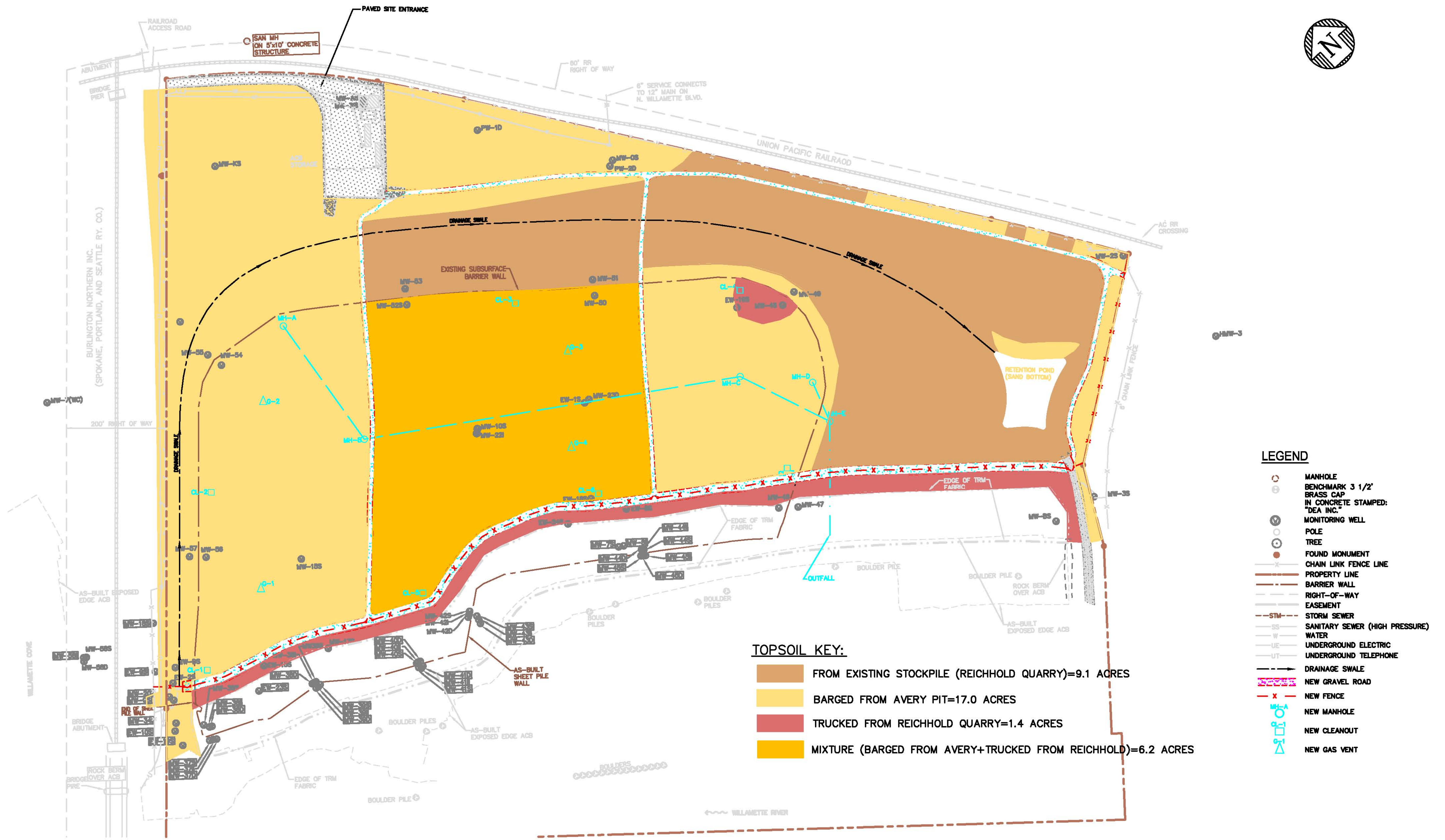


FIGURE 2–1

IMPERMEABLE CAP SECTION

NOT TO SCALE



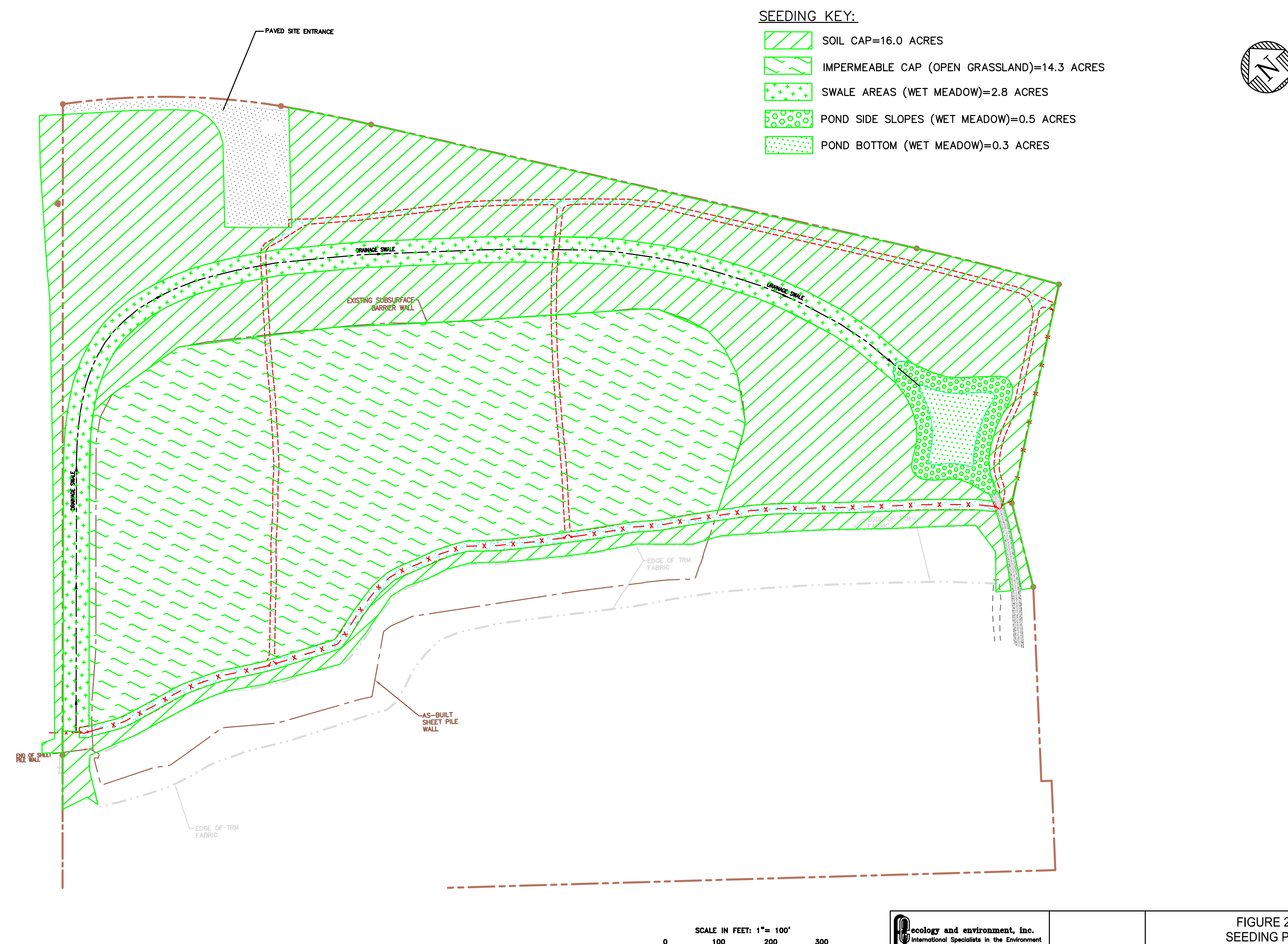
ecology and environment, inc.
International Specialists in the Environment
Portland, Oregon

DESIGNED BY: C. NANCARROW
CHECKED BY:
DRAWN BY: C. NANCARROW
APPROVED BY

FIGURE 2-2
FINAL DISTRIBUTION OF TOPSOIL SOURCES

McCORMICK & BAXTER CREOSOTING CO.
PORTLAND, OREGON

SCALE: NOTED
CAD FILE NO.: upland cap_final.dwg



ecology and environment, inc. International Specialists in the Environment Portland, Oregon		FIGURE 2-3 SEEDING PLAN McCORMICK & BAXTER CREOSOTING CO. PORTLAND, OREGON
DESIGNED BY: C. NANCARROW		
CHECKED BY:		
DRAWN BY: C. NANCARROW	APPROVED BY	SCALE: NOTED; DATE ISSUED:; C.A.D. FILE NO.: upland cap_final.dwg; DRAWING NO.:

NO.	DATE	DWN	APP'D	REVISIONS

N W E S

0 75 150 300 450 600 750

Feet

Scale 1:3,250

Map Reference: Georeferenced Photo Image, October 2005.

MCCORMICK & BAXTER CREOSOTING COMPANY SITE

Portland, Oregon

Figure 2-4

Aerial Photograph

Date:	Drawn by:	Job Number:
1/19/2006	avh	002688.OY21.29.03

3 Project Quantities and Costs

A detailed summary of the RA construction quantities and costs is presented in Table 3-1. The table includes costs associated with the following:

- Upland cap construction activities performed by Wilder;
- Demolition and removal activities performed by Wilder under subcontract to E&E (as described in the *Demolition and Removal Construction Summary Report*, submitted under separate cover);
- Support facility modifications performed by Wilder under subcontract to E&E (as described in the *Support Facility Modifications Construction Summary Report*, submitted under separate cover);
- Engineering/consulting services performed by E&E and its subcontractors; and
- DEQ labor for the RA.

For the Wilder construction portions, the Table 3-1 segregates contractual (i.e., bid) items from change order items. The total bid cost for the upland cap construction contractual items was $4,328,100.00. The actual costs of the upland cap contractual work was $4,356,528.10. The contractual lump sum quantities and costs did not vary from the bid estimate. However, unit price Items 1d, 5d, 5e1, 5e2, 5f, and 5g deviated from the bid estimate, as described below:

- Line Item 1d – Topsoil Import. Estimated 72,200 tons ($1,010,800.00); Actual 74,834.40 tons ($1,047, 681.60);
- Line Item 5d – Monitoring Well Modification. Estimated 33 wells ($49.500.00); Actual 28 wells ($42,000.00);
- Line Item 5e1 – 2" Diameter Monitoring Well Installation. Estimated 90 vertical linear feet ($11,700.00); Actual 110 vertical linear feet ($14,300.00);
- Line Item 5e2 – 4" Diameter Monitoring Well Installation. Estimated 260 vertical linear feet ($44,200.00); Actual 227 vertical linear feet ($38,950.00);
- Line Item 5f – Hazardous Waste Disposal. Estimated 3 tons ($2,400.00); Actual 0 tons ($0.00); and,
- Line Item 5g – Non-Hazardous Waste Disposal. Estimated 10 tons ($1,500.00), actual 39.71 tons ($5,956.50).

During the course of the upland cap construction, ten change orders were approved by DEQ (see Section 2.4). The total cost for all change order work was $289,561.82 (see Table 3-1). The resulting total actual cost for upland cap construction including contractual and change order items was $4,646,089.92.

For the demolition and removal subcontract, the total actual cost from Wilder was $177,209.50, compared to the bid cost of $158, 361.00. Unit price items which deviated from the bid estimate are shown in Table 3-1. Five additional work items totaling $19,934.35 were also issued under this subcontract, resulting in a total subcontract cost of $197,143.85.

For the support facilities modifications subcontract, the total lump sum bid cost from Wilder was $408,000.00. Seven change orders totaling a credit of $71,032.62 were issued under this subcontract, resulting in a total actual subcontract cost of $336,967.38.

In summary, the combined total Wilder construction costs including the upland cap, demolition/removal, and support facility modifications was $5,180,201.15. RA engineering and consulting services performed by E&E and its subcontractors (excluding construction subcontracts to Wilder) totaled $711,371.16, and DEQ management and DOJ legal support costs totaled approximately $120,000, resulting in a total RA cost of $6,011,600.

Table 3-1

SUMMARY OF CONSTRUCTION QUANTITIES AND COSTS
UPLAND CAP CONSTRUCTION (INCLUDING DEMOLITION AND SUPPORT FACILITY SUBCONTRACTS)
MCCORMICK & BAXTER CREOSOTING COMPANY SITE
PORTLAND, OREGON

Item	Description	Units	Unit Price	Estimated (Bid) Quantity	Actual Quantity	Bid Amount	Final Cost
I. UPLAND CAP CONSTRUCTION COSTS (DEQ CONTRACTOR - WILDER):							
1. General							
1.a	Site Mobilization/Demobilization, General	Lump Sum	$215,000.00	1	1	$215,000.00	$215,000.00
1.b	Construction Operations Plan, Contractor Quality Control Plan, Contractor Site Safety Plan, Record Drawings and All Other Submittals	Lump Sum	$8,000.00	1	1	$8,000.00	$8,000.00
1.c	Surveying	Lump Sum	$79,000.00	1	1	$79,000.00	$79,000.00
1.d	Topsoil Import	Tons	$14.00	72,200	74,834.40	$1,010,800.00	$1,047,681.60
2. Subgrade Preparation							
2.a	Clearing, Grubbing and Debris Removal	Lump Sum	$45,000.00	1	1	$45,000.00	$45,000.00
2.b	Tilling	Lump Sum	$20,000.00	1	1	$20,000.00	$20,000.00
2.c	Soil Excavation and Grading	Lump Sum	$95,000.00	1	1	$95,000.00	$95,000.00
3. Impermeable Cap Construction							
3.a	Leveling Layer	Lump Sum	$195,000.00	1	1	$195,000.00	$195,000.00
3.b	Geomembrane	Lump Sum	$299,000.00	1	1	$299,000.00	$299,000.00
3.c	Geocomposite	Lump Sum	$401,000.00	1	1	$401,000.00	$401,000.00
3.d	Sand Drainage Layer	Lump Sum	$770,000.00	1	1	$770,000.00	$770,000.00
3.e	Biotic Barrier Layer	Lump Sum	$302,000.00	1	1	$302,000.00	$302,000.00
3.f	Geotextile Filter Layer	Lump Sum	$83,000.00	1	1	$83,000.00	$83,000.00
3.g	Topsoil Layer	Lump Sum	$85,000.00	1	1	$85,000.00	$85,000.00
3.h	Gas Vents	Lump Sum	$5,500.00	1	1	$5,500.00	$5,500.00
3.i	Manholes	Lump Sum	$24,000.00	1	1	$24,000.00	$24,000.00
3.j	Collection Piping	Lump Sum	$38,000.00	1	1	$38,000.00	$38,000.00
3.k	Conveyance Piping	Lump Sum	$54,000.00	1	1	$54,000.00	$54,000.00
3.l	Outfall Structure	Lump Sum	$6,500.00	1	1	$6,500.00	$6,500.00
4. Soil Cap Construction							
4.a	Demarcation Fabric Layer	Lump Sum	$74,000.00	1	1	$74,000.00	$74,000.00
4.b	Topsoil Layer	Lump Sum	$95,000.00	1	1	$95,000.00	$95,000.00
4.c	Erosion Control Fabric	Lump Sum	$36,000.00	1	1	$36,000.00	$36,000.00
4.d	Retention Pond	Lump Sum	$12,000.00	1	1	$12,000.00	$12,000.00
5. Miscellaneous Items							
5.a	Gravel Acces Roads	Lump Sum	$138,000.00	1	1	$138,000.00	$138,000.00
5.b	Fencing and Gates	Lump Sum	$65,000.00	1	1	$65,000.00	$65,000.00
5.c	Seeding	Lump Sum	$63,000.00	1	1	$63,000.00	$63,000.00
5.d	Monitoring Well Modification	Each	$1,500.00	33	28	$49,500.00	$42,000.00
5.e.1	2" Diameter Monitoring Well Installation	VLF	$130.00	90	110	$11,700.00	$14,300.00
5.e.2	4" Diameter Monitoring Well Installation	VLF	$170.00	260	227	$44,200.00	$38,590.00
5.f	Hazardous Waste Disposal	Tons	$800.00	3	0	$2,400.00	$0.00
5.g	Non-hazardous Waste Disposal	Tons	$150.00	10	39.71	$1,500.00	$5,956.50
CONTRACT TOTAL						**$4,328,100.00**	**$4,356,528.10**
Change Orders							
Change Order No. 1 (No-Cost Change Order)		--	--	--	--	$0.00	$0.00
Change Order No. 2		--	--	--	--	$25,000.00	$25,000.00
Change Order No. 3 (No-Cost Change Order)		--	--	--	--	$0.00	$0.00
Change Order No. 4		--	--	--	--	$23,346.33	$23,346.33
Change Order No. 5		--	--	--	--	$29,111.65	$29,111.65

Table 3-1

SUMMARY OF CONSTRUCTION QUANTITIES AND COSTS
UPLAND CAP CONSTRUCTION (INCLUDING DEMOLITION AND SUPPORT FACILITY SUBCONTRACTS)
MCCORMICK & BAXTER CREOSOTING COMPANY SITE
PORTLAND, OREGON

Item	Description	Units	Unit Price	Estimated (Bid) Quantity	Actual Quantity	Bid Amount	Final Cost
Change Order No. 6		--	--	--	--	$85,605.59	$85,605.59
Change Order No. 7		--	--	--	--	$2,939.92	$2,939.92
Change Order No. 8		--	--	--	--	$24,418.98	$24,418.98
Change Order No. 9		--	--	--	--	$144,000.00	$99,139.35
Change Order No. 10 (No-Cost Change Order)		--	--	--	--	$0.00	$0.00
CHANGE ORDER TOTAL						$334,422.47	**$289,561.82**
TOTAL UPLAND CAP CONSTRUCTION COSTS:							**$4,646,089.92**
II. DEMOLITION AND REMOVAL SUBCONTRACT CONSTRUCTION COSTS (E&E SUBCONTRACTOR - WILDER):							
1. General							
1.a	Site Mobilization/Demobilization, General	Lump Sum	$38,000.00	1	1	$38,000.00	$38,000.00
2. Demolition, Dismantling and Removal							
2.a	Shop Building Demolition	Lump Sum	$25,000.00	1	1	$25,000.00	$25,000.00
2.b	Storage Tanks Removal	Lump Sum	$13,000.00	1	1	$13,000.00	$13,000.00
2.c	Conex Container Relocation	Lump Sum	$5,000.00	1	1	$5,000.00	$5,000.00
2.d	Concrete Demolition and On-Site Disposal	Lump Sum	$5,000.00	1	1	$5,000.00	$5,000.00
2.e	Well Abandonment	VLF	$52.00	730	934	$37,960.00	$48,568.00
2.f	Waterline Removal	LF	$5.00	4300	4906	$21,500.00	$24,530.00
2.g	Waterlines Abandonment In-Place	Lump Sum	$5,000.00	1	1	$5,000.00	$5,000.00
2.h	Gas Lines Removal	LF	$20.00	70	47	$1,400.00	$940.00
2.i	Utility Poles Removal	Each	$250.00	14	7	$3,500.00	$1,750.00
2.j	Sheet Pile Remnants Removal	Lump Sum	$1.00	1	1	$1.00	$1.00
3. Waste Handling, Transportation and Off-Site Disposal							
3.a	RCRA Hazardous Waste Handling, Transportation and Off-Site Disposal	Tons	$600.00	10	17.88	$6,000.00	$10,728.00
3.b	Non-Hazardous Waste Handling, Transportation and Off-Site Disposal	Tons	$100.00	30	25.44	$3,000.00	$2,544.00
3.c	Scrap Metal Handling, Transportation and Recycling	Tons	($50.00)	120	57.03	($6,000.00)	($2,851.50)
SUBCONTRACT SUBTOTAL						**$158,361.00**	**$177,209.50**
Force Account Work (Modifications to Scope of Work)							
FA1	Asbestos PAS Subcontract	Force Account	--	--	--	--	$5,641.51
FA2	PCB Transformer	Force Account	--	--	--	--	$2,293.20
FA3	Labor and Equipment	Force Account	--	--	--	--	$11,999.64
FORCE ACCOUNT WORK TOTAL							**$19,934.35**
TOTAL DEMOLITION AND REMOVAL SUBCONTRACT CONSTRUCTION COSTS:							**$197,143.85**
III. SUPPORT FACILITY MODIFICATIONS SUBCONTRACT CONSTRUCTION COSTS (E&E SUBCONTRACTOR - WILDER):							
1. General							
1.a	All Work Except Reinforced Concrete and Security Guard Including:	Lump Sum	$380,000.00	1	1	$380,000.00	$380,000.00
	Mobilization, Insurance/Bonds ($47,000.00)						
	Site Prep ($10,000)						
	Waterline ($50,000)						
	Grading/Base Aggregates ($100,000)						
	Paving ($42,000)						
	Building ($56,000)						
	Electrical ($50,000)						
	Fencing ($25,000)						

Table 3-1

SUMMARY OF CONSTRUCTION QUANTITIES AND COSTS
UPLAND CAP CONSTRUCTION (INCLUDING DEMOLITION AND SUPPORT FACILITY SUBCONTRACTS)
MCCORMICK & BAXTER CREOSOTING COMPANY SITE
PORTLAND, OREGON

Item	Description	Units	Unit Price	Estimated (Bid) Quantity	Actual Quantity	Bid Amount	Final Cost
1.b	Reinforced Concrete, Including Reinforcing, Forming and All Other Items Ancillary to Concrete Work	CY	$500.00	56	See Item 6 of Change Order No. 1.	$28,000.00	$28,000.00
SUBCONTRACT TOTAL						**$408,000.00**	**$408,000.00**
Change Order No. 1							
1	Delete requirement to pave with asphalt.	--	--	--	--	--	($42,000.00)
2	Delete requirement to provide chain-link fence.	--	--	--	--	--	($25,000.00)
3	Provide new sanitary holding tank beneath trailer with toilet. Chlorinate old holding tank and dispose.	--	--	--	--	--	$467.38
4	Use PVC conduit and bury conduit beneath access road. Use EMT in new shop at 4' and higher above finished floor elevation.	--	--	--	--	--	($3,500.00)
5	Provide primed non-corrosion resisting steel garage doors in lieu of CRES doors.	--	--	--	--	--	($1,000.00)
6	Increase in reinforced concrete volume from 56 CY to 58.40 CY at the bid unit price of $500/CY.	--	--	--	--	--	$1,200.00
7	Delete air terminals and cabling.	--	--	--	--	--	($1,200.00)
CHANGE ORDER NO. 1 TOTAL							**($71,032.62)**
TOTAL SUPPORT FACILITY MODIFICATIONS SUBCONTRACT CONSTRUCTION COSTS:							**$336,967.38**
TOTAL CONSTRUCTION COSTS (INCLUDING UPLAND CAP, DEMOLITION/REMOVAL, AND SUPPORT FACILITY)							**$5,180,201.15**
IV. E&E COSTS							
Task 22	RA Site-Specific Plans (e.g., CQAP, PCP, BMRP)						$15,675.54
Task 23	Contractor Procurement Support						$39,655.33
Task 24	Contractor Management Support (includes $2,430 for PacRim Geotechnical sub)						$150,162.90
Task 25	Resident Inspection Services						$346,411.81
Task 27	Remedial Action (note, although the demo and support facility subcontracts were performed under this task, the cost shown does not include these subcontract costs, since they are itemized separately above. The cost shown reflects other Remedial Action work completed including the haz waste area cover; ACB move and road repair; MW-1s investigation; and oversight)						$101,621.58
Task 29	Construction Summary Report						$57,844.00
TOTAL E&E COSTS							**$711,371.16**
V. DEQ MANAGEMENT AND DOJ LEGAL SUPPORT							**$120,000**
TOTAL UPLAND CAP CONSTRUCTION COST							**$6,011,600**

4 References

Ecology and Environment, Inc. (E&E), 2006, *Demolition and Removal Construction Summary Report*, submitted to DEQ, prepared by E&E-Portland, OR.

______, 2006, *Support Facility Modifications Construction Summary Report*, submitted to DEQ, prepared by E&E-Portland, OR.

______, 2006, *Sediment Cap Construction Summary Report*, submitted to DEQ, prepared by E&E-Portland, OR.

______, May 2005, *Upland Cap Construction Quality Assurance Plan*, submitted to DEQ, prepared by E&E-Portland, OR.

______, March 2005, *Upland Cap Contract Documents and Drawings*, submitted to DEQ, prepared by E&E-Portland, OR.

______, July 2004, *Upland Cap Pre-Final Design Report*, submitted to DEQ, prepared by E&E-Portland, OR.

______, February 2004, *Soil Cap Design Criteria Report*, submitted to DEQ, prepared by E&E-Portland, OR.

National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries), 2002, *Biological Opinion for Construction of the Barrier Wall at the McCormick & Baxter Creosoting Company Superfund Site, Willamette River, Portland, Oregon*, submitted to EPA, Oregon Operations Office.

Oregon Department of Environmental Quality (DEQ), September 2004, *McCormick & Baxter Soil Cap Design Decision Meeting.*

United States Environmental Protection Agency (EPA), January 2005, *Biological Assessment Addendum (III) for McCormick & Baxter Creosoting Company, Portland, Oregon, Upland Soil Cap Remedy*, submitted to the National Marine Fisheries Service (NOAA Fisheries).

______, 1995, *Remedial Design/Remedial Action Handbook* (EPA 540/R-95-059).

United States Environmental Protection Agency and the State of Oregon Department of Environmental Quality (EPA/DEQ), December 2003, *Archaeological Monitoring Protocol*, prepared for the McCormick & Baxter Creosoting Site, Portland, Oregon.

, August 2002, *Explanation of Significant Difference (OU3 – Final Groundwater)*, prepared for the McCormick & Baxter Creosoting Site, Portland, Oregon.

, March 1998, *Amended Record of Decision*, prepared for the McCormick & Baxter Creosoting Site, Portland, Oregon.

, 1996, *Record of Decision*, prepared for McCormick & Baxter Creosoting Company, Portland, Oregon.

A Soil Cap Design Decision Meeting Minutes

B Submittal Log and Select Material Submittals

C Biological Assessment Addendum (III)

D Placement Verification Forms and Compaction Test Results

E Soil Testing

F Change Orders, Work Directives, and Other Correspondances

G Press Release and Archaeological Survey

H Daily Field Reports

I

Photodocumentation

PHOTOGRAPH IDENTIFICATION SHEET McCormick & Baxter Barrier Wall Construction Project No. 002688.OY21.29.03					
Photo No.	**Date**	**Time**	**By**	**Direction**	**Description**
1	6/08/05	13:53	LK	S	Subgrade preparation along eastern edge of property.
2	6/10/05	12:50	LK	NE	Subgrade grading and cut/fill near NE corner of property.
3	6/16/05	7:52	LK	W	Subgrade activities for the impermeable cap.
4	6/16/05	8:00	LK	NW	Placement of large woody debris along the top of bank.
5	6/22/05	15:36	LK	SW	Subgrade activities at the future retention pond location.
6	6/23/05	11:16	LK	E	Wood chipping clearing/grubbing materials.
7	6/21/05	8:01	LK	SW	Clearing bank on Metro property for barge off-loading.
8	6/08/05	14:20	LK	SW	Manhole D with a partially installed pipe to Manhole E.
9	6/10/05	10:56	LK	Down	Applying grease to the ends of conveyance piping prior to coupling.
10	6/08/05	16:18	LK	E	Welding apparatus used for joining HDPE smooth wall interior conveyance pipe sections.
11	6/13/05	9:23	LK	Down	Excavator used to slide the smooth wall interior conveyance piping into the outer corrugated piping.
12	6/14/05	9:40	LK	W	Installation of Manhole E.
13	6/16/05	9:51	LK	NE	Form for concrete outfall structure being constructed.
14	7/19/05	18:05	LK	E	Outfall structure and 12” minus rock below the outfall.
15	6/16/05	7:41	LK	SE	Cascade Drilling performing well extensions.
16	6/21/05	13:02	LK	SE	Cascade Drilling installing MW-1r.
17	6/27/05	11:59	LK	SW	Sand being loaded into the hopper from the barge.
18	6/28/05	15:50	LK	NW	Placing the leveling sand layer.
19	6/30/05	14:42	LK	NW	Rough placement of sand leveling layer nearly completed.
20	6/29/05	10:35	LK	N	Haul road of clean topsoil being spread over demarcation fabric.
21	6/30/05	14:51	LK	SW	Topsoil from the existing stockpile being spread out over demarcation fabric.
22	7/06/05	7:35	LK	W	First panel of geomembrane being installed along the north end of the impermeable cap footprint.
23	7/11/05	7:12	LK	SE	Geomembrane being deployed utilizing a roller.
24	7/06/05	15:07	LK	NW	Welding gemembrane panels with wedge welding machine.
25	7/16/05	16:06	LK	E	Installation of boot around Manhole B.
26	7/20/05	17:42	LK	Down	Boot and clamp installed on monitoring well.
27	7/07/05	9:20	LK	Down	Air pressure testing geomembrane seam.
28	7/12/05	9:33	LK	S	Vacuum testing geomembrane patch.
29	7/08/05	11:16	LK	NW	Overview of site with completed leveling layer and

PHOTOGRAPH IDENTIFICATION SHEET McCormick & Baxter Barrier Wall Construction Project No. 002688.OY21.29.03					
Photo No.	**Date**	**Time**	**By**	**Direction**	**Description**
					partial installation of geomembrane.
30	7/15/05	11:30	LK	W	Seams of geocomposite zip-tied together (left), and seams after they've been heat-tacked (right).
31	7/29/05	8:31	LK	E	Butt seam of geocompostie zip-tied together.
32	7/25/05	12:21	LK	N	Overview of site showing four layers of impermeable cap. Starting from the foreground: sand leveling layer, geomembrane layer, geocomposite layer, and drainage sand layer.
33	7/27/05	14:26	LK	NW	Placement of the drainage sand layer.
34	7/29/05	7:46	LK	E	Placement of 4" minus biotic rock.
35	8/02/05	12:50	LK	NW	Overview of site showing three layers of impermeable cap. Starting from the foreground: geocomposite layer, drainage sand layer, and 4" minus biotic rock layer.
36	8/12/05	11:39	LK	W	Overview of site showing biotic rock layer and overlying geotextile layer.
37	8/17/05	7:49	LK	W	Placement of gravel for access road across the impermeable cap.
38	8/19/05	7:47	LK	W	Topsoil unloaded from barge with conveyor.
39	8/16/05	11:37	LK	NW	Topsoil being placed over geotextile within the impermeable cap footprint.
40	8/18/05	14:04	LK	NW	Overview of site showing three layers of impermeable cap. Starting from the foreground: 4"minus biotic rock, geotextile, and topsoil.
41	8/31/05	8:33	LK	NW	Topsoil placement complete over the impermeable cap footprint.
42	8/17/05	14:04	LK	S	Deploying erosion control netting along the swale area.
43	9/02/05	9:07	LK	E	Erosion control netting installed around pond spillway.
44	8/16/05	8:10	LK	N	Gravel road along top of the bank.
45	8/31/05	8:47	LK	W	Willamette Fence Co. digging post holes.
46	9/26/05	7:56	LK	W	New fencing and gates installed in the south corner of support facility area.
47	8/31/05	10:51	LK	NW	Materials for hydroseeding arriving on-site.
48	9/06/05	11:10	LK	E	Placing mineral supplements into hydroseeding mixing tank.
49	9/06/05	10:30	LK	N	Applying hydroseed on the impermeable cap topsoil.
50	9/09/05	8:04	LK	NW	Applying compost prior to hydroseeding on bank areas disturbed during construction.
51	9/10/05	10:33	LK	NW	Paving of the support facility pad.
52	9/14/05	10:37	LK	N	Applying epoxy into holes of manhole pad for connection to ladders.

PHOTOGRAPH IDENTIFICATION SHEET McCormick & Baxter Barrier Wall Construction Project No. 002688.OY21.29.03					
Photo No.	**Date**	**Time**	**By**	**Direction**	**Description**
53	8/10/05	10:57	LK	W	Completed test patch of organoclay mats.
54	10/21/05	13:37	LK	NW	Deployment of organoclay mats utilizing an excavator and spreader bar for large organoclay patch.
55	10/22/05	16:19	LK	W	Covering organoclay mats with a 12” layer of sand.
56	10/25/05	10:24	LK	NW	Placing 10” minus rock over organoclay mat area.
57	10/25/05	15:16	LK	W	Completed organoclay mat patch.
58	11/08/05	13:25	LK	NW	Overview of completed site.

Key:
No. = Number
LK = Lenna Kennard
N = North
NE = Northeast
NW = Northwest
S = South
SE = Southeast
SW = Southwest
E = East
W = West

J Meeting Minutes

K Record Drawings